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ADDENDUM (83026R02) IS NOW INCLUDED IN THIS REPORT.

12a. DISTRIBUTION/AVAILABILITY STATEMENT

APPROVED FOR PUBLIC RELEASE; DISTRIBUTION IS UNLIMITED

12b. DISTRIBUTION CODE

13. ABSTRACT *(Maximum 200 words)*

THE PURPOSE OF THIS REPORT IS TO PROVIDE TECHNICAL GUIDANCE IN EVALUATING HAZARDOUS WASTE ALTERNATIVES AND TO IDENTIFY THE ELEMENTS NECESSARY IN DEVELOPING A DISPOSAL STRATEGY. THE SCOPE OF WORK FOR THIS PROJECT INCLUDED:

1. ANALYSIS OF EXISTING APPROVED HAZARDOUS WASTE DISPOSAL SITES IN THE REGION;
2. ANALYSIS OF THE GEOLOGY AND HYDROGEOLOGY OF RMA TO DETERMINE THE SUITABILITY OF AN ON-SITE LANDFILL;
3. REVIEW OF GOVERNMENT REGULATIONS CONCERNING HAZARDOUS WASTE DISPOSAL.

TWO OPTIONS WERE EXPLORED: OFF-SITE DISPOSAL AT AN EPA APPROVED FACILITY OR AN ON-SITE FACILITY IN SECTION 36.

THE ADDENDUM IS A GEOTECHNICAL ASSESSMENT OF THE SUITABILITY OF THREE ALTERNATIVE SITES FOR AN ON-SITE LANDFILL. THE SITES COVER ABOUT 35 ACRES IN SECTIONS 19, 20, AND 30.

14. SUBJECT TERMS

GEOLOGY, HYDROLOGY, REGULATIONS, TREATMENT, CHEMICALS

15. NUMBER OF PAGES

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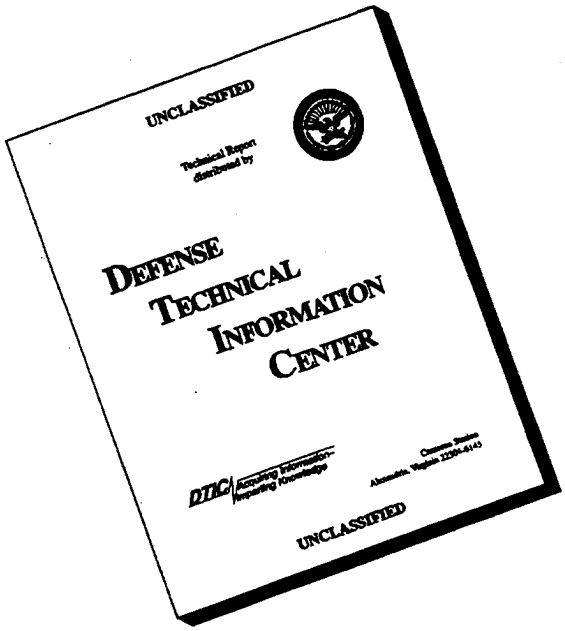

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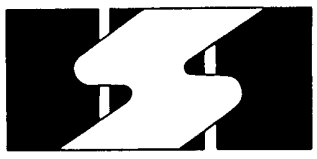
ROCKY MOUNTAIN ARSENAL
HAZARDOUS WASTE DISPOSAL SITE
ECTION, CRITERIA DEVELOPMENT AND SITING STUDY
CONTRACT NO. DAAA05-82-M-0078

Consulting Geohydrologists
and
Groundwater Geologists



ROCKY MOUNTAIN ARSENAL
HAZARDOUS WASTE DISPOSAL SITE
SELECTION, CRITERIA DEVELOPMENT AND SITING STUDY
CONTRACT NO. DAAA05-82-M-0078

May, 1982

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TECHNICAL OPERATIONS DIRECTORATE
Commerce City, Colorado

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ROCKY MOUNTAIN ARSENAL
HAZARDOUS WASTE DISPOSAL SITE
SELECTION, CRITERIA DEVELOPMENT AND SITING STUDY
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EXECUTIVE SUMMARY AND CONCLUSIONS

1. The alternatives assessed within this scope of work for Rocky Mountain Arsenal for disposal of hazardous wastes from Basin F are either off-site disposal, to an approved hazardous waste landfill facility, or disposal on-site at the Arsenal.

2. The off-site facilities that might be available to RMA are either the existing Lowry Landfill site or the proposed Last Chance site.

3. There are two principle issues related to off-site disposal: (1) the availability of either the Lowry Landfill or Last Chance site to accept RMA wastes; and (2) the cost of disposal at either of these sites. Because of some technical and political concerns associated with the Lowry Landfill, it is unlikely that it would be available for RMA's disposal requirements.

4. Based on the assumed final volume of material to be disposed of from Basin F, it is estimated that disposal costs for utilizing the Last Chance site could range between about 22 million dollars and 134 million dollars. This assumes that all final Basin F material will be classified as a solid waste. Transportation costs added to actual disposal costs would increase the total disposal cost by between about 8 million dollars and 11 million dollars.

5. Disposal of hazardous waste material from Basin F on-site was evaluated for a site within Section 36 of the Arsenal.

6. Preliminary geotechnical information on the preferred Section 36 site indicates that the construction and operation of a hazardous waste landfill is technically feasible.

7. The construction and operation of an on-site hazardous waste disposal facility is subject to regulation under the Resource Recovery and Conservation Act (RCRA).

8. Colorado state regulations concerning hazardous waste disposal, at present, do not include on-site waste disposal facilities. However, it is expected that, at minimum, State regulations for off-site disposal will cover on-site activities if and when the State obtains regulatory authority for such on-site activities.

I. INTRODUCTION

The purpose of this report is to provide Rocky Mountain Arsenal (RMA) technical guidance in evaluating its hazardous waste disposal alternatives and to identify the elements necessary in developing a disposal strategy. With respect to disposal of hazardous waste, two options were evaluated:

1. Packaging, transporting and disposing hazardous waste at a commercial landfill that is approved for accepting such waste; and

2. Constructing a suitable on-site facility that would meet Federal and State hazardous waste regulations.

A. Scope of Work

The scope of work for this project included:

1. An analysis of existing regional approved hazardous waste disposal sites.

2. An analysis of the geology and hydrogeology of RMA to determine the suitability of a proposed site for construction and operation of an on-site hazardous waste landfill.

3. A review of existing Federal, State and local government regulations concerning hazardous waste disposal.

B. Methodology

The approach used to evaluate RMA's hazardous waste disposal alternatives was based on the following assumptions: (1) all hazardous waste will be classified as solid waste; (2) the waste to be disposed of comes entirely from Basin F; (3) off-site disposal alternatives are restricted with respect to their geographic location; and (4) RMA has a prefered site available on the Arsenal, should on-site disposal be the preferred alternative, and it is this alternative site that is to be evaluated.

The off-site disposal alternatives were evaluated based on discussions with Chemical Waste Management Incorporated, operator of the Denver Arapahoe Chemical Waste Processing Facility (Lowry Landfill) and Browning-Ferris Industries, operator of the proposed Highway 36 Land Development Disposal Facility (Last Chance site). Neither company would provide information with respect to disposal costs without submitting a waste material profile sheet and actual samples of the waste material to be disposed of for analyses by their own laboratories. With respect to off-site transportation, both firms indicated that they could provide this service. However, neither would supply any transportation cost estimates.

The proposed on-site landfill at RMA was evaluated based on the geotechnical information available from numerous Arsenal studies and discussions with personnel from RMA and WES. The site evaluation and

design criteria developed for the preferred Arsenal site are based on the performance standards set forth in the regulations which are intended to minimize damage to the human and physical environment.

Review of Federal, State and local regulations affecting hazardous waste disposal was undertaken to identify the regulatory requirements for permitting an on-site hazardous waste landfill facility. This review included an analysis of the Federal and State laws and their associated regulations. In addition, contact was made with personnel from the EPA Region VIII and Colorado State Department of Health to provide an update of the status of various regulatory requirements and an interpretation of some of these.

II. HAZARDOUS WASTE DISPOSAL

A. Disposal Alternatives

The alternatives of disposal for Basin F hazardous wastes are twofold:

(1) off-site disposal at an EPA approved hazardous waste disposal facility; or,

(2) disposal on-site at RMA.

At present there is only one existing RCRA approved landfill in the region that might be utilized, the Chemical Waste Processing Facility east of Aurora, Colorado. Another site, the Last Chance site near Byers, Colorado is in the process of obtaining RCRA certification. With respect to on-site disposal at RMA, a proposed site would have to be approved under RCRA regulaton as administered by the EPA. The Colorado State Department of Health at present does not have jurisdiction for on-site disposal of hazardous wastes but does have regulatory authority with respect to water quality. Each of these alternatives have different costs associated with them.

There are two concerns with off-site disposal:

(1) the availability of these sites to accept RMA wastes; and,

(2) cost of disposal at privately operated hazardous waste landfill facilities.

At present, the Last Chance site, to be operated by Browning-Ferris Industries, Inc. has not yet obtained all approvals. Although the EPA has given conditional approval for that site, the State of Colorado has not given its approval. The Company had anticipated to be in operation by April of 1982. The Chemical Waste Processing Facility (Lowry Landfill) is presently operating under emergency approval. Recently, there have been serious questions raised as to the adequacy of protecting the environment from some hazardous wastes that were disposed of prior to the implementation of RCRA. There is considerable political pressure to close down that facility. Whether or not this will happen, remains to be seen.

Off-site disposal includes various costs for disposal, including disposal fees charged by the operators of those private facilities, costs in transporting the waste from RMA to the disposal facility, and handling of removal costs of waste material from Basin F. This latter cost is one that would most likely be incurred directly by RMA. The disposal costs are fees paid to the operators. It is likely that the waste transportation costs would be under the management of the private operators.

Neither Chemical Waste Management, Inc. nor Browning-Ferris Industries would provide estimates of transportation and disposal fees without providing a sample of waste material and completing a waste characterization form (Exhibits 1 and 2). However, data provided by Browning-Ferris in their application for the Last Chance site provide

THIS FORM HAS BEEN DEVELOPED BY AND FOR THE USE OF CHEMICAL WASTE MANAGEMENT, INC. AND OTHER WASTE MANAGEMENT, INC. COMPANIES.

SALES CODE	
	A 53030

WASTE PROFILE SHEET CODE

GENERATOR'S WASTE MATERIAL PROFILE SHEET

GENERAL DIRECTIONS: In order for us to determine whether we can lawfully, safely and environmentally transport, store, treat or dispose of your waste stream, we must ask certain information about your waste. All of the information we seek is necessary, for our purposes and yours. Be complete in your answers: if your response is "none," so indicate. Answers must be in ink or typewritten. Information you provide will be maintained in strictest confidence. Please make a copy of this form for your records, returning the original to the location indicated below.

THIS FORM AND ANY SUPPLEMENTAL INFORMATION SHOULD BE RETURNED TO:

_____

_____

_____

_____

1. GENERATOR NAME: _____
2. GENERATING FACILITY NAME/ADDRESS/USEPA FACILITY I.D. NUMBER (IF ANY): _____

   _____

   _____
3. COMPANY CONTACTS:

   GENERAL _____ TITLE _____ PHONE _____

   _____ TITLE _____ PHONE _____

   TECHNICAL _____ TITLE _____ PHONE _____

   _____ TITLE _____ PHONE _____
4. WASTE NAME: _____
5. PROCESS GENERATING WASTE: _____

   _____
6. WASTE CHARACTERISTICS:

   A. PHASES/LAYERS: BILAYERED ☐ MULTILAYERED ☐ NONE ☐

   B. PHYSICAL STATE AT 70°F: SOLID ☐ SEMI-SOLID ☐ LIQUID ☐

   POWDER ☐ OTHER: _____

   C. SOLIDS: TOTAL (%): _____ TOTAL DISSOLVED (ppm or %): _____

   D. SPECIFIC WEIGHT (AS # PER UNIT): _____

   E. pH: _____ (Show the following as range of %)

AS:	H_2SO_4	___ – ___ %	H_3PO_4	___ – ___ %
	HC1	___ – ___ %	NaOH	___ – ___ %
	HF	___ – ___ %	NH_4OH	___ – ___ %
	HNO_3	___ – ___ %	$Ca(OH)_2$	___ – ___ %
OTHER:	___	___ – ___ %	___	___ – ___ %
	___	___ – ___ %	___	___ – ___ %

   F. FLASH POINT: _____ °F (CLOSED CUP TEST ONLY)

   G. VAPOR PRESSURE (in mm of Hg at 25°C): _____

   H. BTU PER #: _____ ASH CONTENT _____ %

   I. CHARACTERISTIC COLOR _____ DISTINCTIVE ODOR _____

   J. HALOGENATED? _____ % SULFONATED? _____ %

   K. ALPHA RADIATION AS pCi/l: _____

7. WASTE COMPOSITION:

A. ORGANIC COMPONENTS (WITH RANGES — INDICATE WHETHER % OR ppm)

_____ — _____ _____ — _____

_____ — _____ _____ — _____

_____ — _____ _____ — _____

_____ — _____ _____ — _____

(ATTACH ADDITIONAL PAGES IF NECESSARY)

DOES THIS WASTE CONTAIN ENDRIN, LINDANE, METHOXYCHLOR, TOXAPHENE, 2,4-D, 2,4,5-TP SILVEX, OR ANY OTHER ORGANIC COMPOUNDS LISTED BY USEPA AT 40 CFR 261.24? _____ IF SO, PLEASE NOTE ABOVE.

B. HEAVY METALS (WITH ppm RANGES):

	TOTAL	TOTAL LEACHABLE		TOTAL	TOTAL LEACHABLE
Ag			Hg		
As			Ni		
Ba			Pb		
Cd			Se		
Cr			Zn		
Cu			Other (ATTACH ADDITIONAL PAGES)		

(IF YOU HAVE DETERMINED TOTAL LEACHABLES USING USEPA'S "EP TOXICITY TEST PROCEDURE" — AT 40 CFR, PART 261, APPENDIX II — SO INDICATE BY MARKING "EP" AFTER THE RESULT SHOWN ABOVE.)

C. INORGANIC COMPONENTS (WITH % RANGES): OTHER

TOTAL CYANIDE	____ — ____ %		____ — ____ %	
FREE CYANIDE	____ — ____ %		____ — ____ %	
SULFIDE AS:	____ — ____ %		____ — ____ %	
BISULFITE AS:	____ — ____ %		____ — ____ %	
SULFITE AS:	____ — ____ %		____ — ____ %	

(ATTACH ADDITIONAL PAGES IF NECESSARY)

D. DOES THIS WASTE STREAM CONTAIN BIOLOGIC MATERIALS, PATHOGENS, OR ETIOLOGICAL AGENTS? _____ IF SO, ATTACH ADDITIONAL PAGES DESCRIBING SUCH MATERIALS.

E. IS THE WASTE A PESTICIDE OR PRODUCED BY A PESTICIDE MANUFACTURING PROCESS? _____ IF SO, INDICATE WHETHER IT CONTAINS:

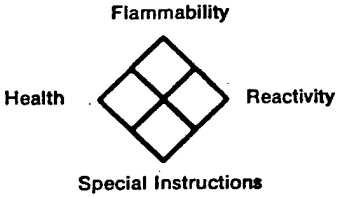
- ☐ ORGANOPHOSPHATES — CONTAINING SULFUR ☐ YES ☐ NO
- ☐ CARBAMATES
- ☐ CHLORINATED HYDROCARBONS

8. HAZARDOUS COMPONENTS AND CHARACTERISTICS

A. HAZARDOUS PROPERTIES (INSERT NUMBER CODES PER INSTRUCTIONS ON LAST PAGE)

(1) TOXICITY RATING: INHALATION _____ DERMAL _____ ORAL _____

(2) HAZARD IDENTIFICATION SYSTEM:



B. LIST ANY OTHER ACUTE OR CHRONIC HAZARDS ASSOCIATED WITH OR ALLEGED TO BE ASSOCIATED WITH HUMAN CONTACT WITH OR EXPOSURE TO THE WASTE: _____

_____

_____

_____

_____

SALES	CODE

WASTE PROFILE SHEET CODE

CERTIFICATION OF REPRESENTATIVE SAMPLE

GENERAL DIRECTIONS: IN ORDER TO DETERMINE WHETHER WE CAN ACCEPT THE SPECIAL WASTE DESCRIBED IN THE ABOVE NUMBERED PROFILE SHEET, WE MUST OBTAIN A REPRESENTATIVE SAMPLE OF THE WASTE. WE WILL ANALYZE THE SAMPLE TO VERIFY THE INFORMATION YOU HAVE PROVIDED US, SO IT IS PARTICULARLY IMPORTANT THAT THE SAMPLE BE TRULY REPRESENTATIVE. IN MOST CIRCUMSTANCES YOU WILL BE OBTAINING THE SAMPLE. HOWEVER, IN THOSE CASES IN WHICH WE OBTAIN THE SAMPLE, WE MUST ASK THAT ONE OF YOUR EMPLOYEES BE PRESENT TO DIRECT THE PARTICULAR SOURCE TO BE SAMPLED AND TO WITNESS THE SAMPLING. IN SUCH CASE, YOUR EMPLOYEE MUST SIGN THIS CERTIFICATION AS A WITNESS.

THIS CERTIFICATION MUST BE RETURNED, WITH THE REPRESENTATIVE WASTE SAMPLE, TO:

_____ _____
_____ _____
_____ _____
_____ _____

THE UNDERSIGNED CERTIFIES THAT HE/SHE OBTAINED A REPRESENTATIVE SAMPLE OF THE WASTE MATERIAL DESCRIBED IN THE "GENERATOR'S WASTE MATERIAL PROFILE SHEET" ABOVE REFERENCED, AND THAT THE FOLLOWING REPRESENTATIONS ARE TRUE AND CORRECT:

1. HOUR AND DATE OF SAMPLING: _____
2. SOURCE FROM WHICH SAMPLE TAKEN: _____
   _____
   _____
3. EQUIPMENT AND SAMPLING METHOD USED: _____
   _____
   _____
   _____
4. AMOUNT OF SAMPLE OBTAINED: _____
5. TYPE OF CONTAINER INTO WHICH SAMPLE WAS PLACED: _____
   _____
6. THE SAMPLING EQUIPMENT USED, AND THE CONTAINER INTO WHICH THE SAMPLE WAS PLACED, WERE THEMSELVES UNCONTAMINATED BEFORE USE.
7. AT THE TIME OF SAMPLING I AFFIXED A LABEL TO THE CONTAINER IN THE FOLLOWING FORM WITH THE FOLLOWING INFORMATION (FILL IN THIS PORTION, INCLUDING YOUR SIGNATURE, JUST AS IT APPEARS ON THE LABEL YOU PREPARED):

GENERATOR:
SAMPLE HOUR/DATE:
PROFILE SHEET CODE:
SAMPLER SIGNATURE:

WITNESS VERIFICATION. I WAS PERSONALLY PRESENT DURING THE SAMPLING DESCRIBED; I DIRECTED THE WASTE SOURCE TO BE SAMPLED; AND I VERIFY THE INFORMATION ABOVE NOTED

WITNESS: _____

SIGNATURE: _____

TITLE: _____

EMPLOYER: _____

DATE: _____

SAMPLER NAME: _____

SIGNATURE: _____

TITLE: _____

EMPLOYER: _____

DATE: _____

LABORATORY REVIEW OF SAMPLING PROTOCOL.

BASED UPON MY REVIEW OF THE ABOVE PROFILE SHEET, I CONCLUDE THAT THE ABOVE METHODOLOGY IS:

☐ ADEQUATE FOR YIELDING A REPRESENTATIVE SAMPLE.

☐ INADEQUATE FOR THE REASONS NOTED HEREON.

DATE: _____

LAB MGR: _____

FORM WMI-51 (Rev 11-5-80)

9. REGULATORY CLASSIFICATION OF WASTE

A. IS THIS WASTE A "HAZARDOUS MATERIAL" AS DEFINED BY REGULATIONS OF THE U.S. DEPARTMENT OF TRANSPORTATION PURSUANT TO THE HAZARDOUS MATERIALS TRANSPORTATION ACT? _____ (SEE 49 CFR 172.101 AND 173 FOR "HAZARDOUS MATERIALS" LIST AND CHARACTERISTICS.) IF SO, PLEASE ADVISE OF THE FOLLOWING:

(1) CORRECT SHIPPING DESCRIPTION: _____

(2) HAZARD CLASS(ES): _____

(3) MATERIAL I.D. NO.(S) _____

B. DOES THIS WASTE CONTAIN ANY "HAZARDOUS SUBSTANCE" AS DEFINED BY REGULATIONS OF THE U.S. ENVIRONMENTAL PROTECTION AGENCY PURSUANT TO SECTION 311 OF THE CLEAN WATER ACT? _____ (SEE 40 CFR 117 FOR "HAZARDOUS SUBSTANCES" AND CATEGORIES.) IF SO, PLEASE ADVISE OF THE FOLLOWING:

(1) THE NAMES OF EACH HAZARDOUS SUBSTANCE PRESENT IN THE WASTE, THE HAZARD CATEGORY (X, A, B, C OR D) AND THE APPROXIMATE CONCENTRATION OF THE SUBSTANCE BY WEIGHT IN THE WASTE:

_____

_____

_____

(ATTACH ADDITIONAL PAGES IF NECESSARY)

C. IS THIS WASTE A "HAZARDOUS WASTE" AS DEFINED BY REGULATIONS OF THE U.S. ENVIRONMENTAL PROTECTION AGENCY PURSUANT TO SECTION 3001 OF THE RESOURCE CONSERVATION AND RECOVERY ACT? _____ (SEE 40 CFR, PART 261 FOR WHAT IS A "HAZARDOUS WASTE.") IF SO, STATE:

(1) THE USEPA HAZARDOUS WASTE NUMBER(S): _____

(2) DO YOU CLAIM TO BE A SMALL QUANTITY GENERATOR? _____ (SEE 40 CFR 261.5.)

D. IS THIS WASTE A "HAZARDOUS WASTE" AS DEFINED BY THE ENVIRONMENTAL REGULATORY AGENCY IN YOUR STATE? _____ IF SO, STATE WHY IT IS SO DEFINED AND ANY STATE HAZARDOUS WASTE CODE NUMBERS ASSIGNED: _____

_____

10. IS THE INFORMATION PROVIDED IN SECTIONS 6-9 BASED UPON LABORATORY ANALYSIS OF THE WASTE MATERIAL? _____ IF SO, PLEASE ADVISE OF THE DATE OF THE MOST RECENT ANALYSIS: _____

11. HAVE YOU OBTAINED TOXICITY STUDIES OF THIS WASTE STREAM? _____ IF SO, PLEASE ATTACH A COPY OF THE RESULTS.

12. QUANTITY/SHIPPING REQUIREMENTS:

ANTICIPATED VOLUME IS: _____

GALLONS ☐ TONS ☐ CUBIC YARDS ☐ DRUMS ☐ OTHER ☐ _____

PER: DAY ☐ WEEK ☐ MONTH ☐ YEAR ☐ ONE TIME ☐

TRANSPORTATION EQUIPMENT REQUIRED: _____

_____

SERVICE/SCHEDULING REQUIREMENTS: _____

_____

GENERATOR'S
AUTHORIZED SIGNATORY: _____ TITLE _____ DATE _____

CONFIDENTIALITY AGREEMENT: _____,
as consideration for the Generator's release of the above information, and any other supplemental data provided, agrees to treat such information as confidential property and will not disclose such information to others except as is required by law, and in such circumstances only after first giving notice to the Generator.

By: _____
Name

_____
Title

TOXICITY RATINGS

0 = No Toxicity

This designation is given to materials which fall into one of the following categories:

(a) Materials which cause no harm under any conditions of normal use.

(b) Materials which produce toxic effects on humans only under the most unusual conditions or by overwhelming dosage.

1 = Slight Toxicity

(a) *Acute local.* Materials which on single exposures lasting seconds, minutes or hours cause only slight effects on the skin or mucous membranes regardless of the extent of the exposure.

(b) *Acute systemic.* Materials which can be absorbed into the body by inhalation, ingestion, or through the skin and which produce only slight effects following single exposures lasting seconds, minutes, or hours, or following ingestion of a single dose, regardless of the quantity absorbed or the extent of exposure.

(c) *Chronic local.* Materials which on continuous or repeated exposures extending over periods of days, months, or years cause only slight and usually reversible harm to the skin or mucous membranes. The extent of exposure may be great or small.

(d) *Chronic systemic.* Materials which can be absorbed into the body by inhalation, ingestion, or through the skin and which produce only slightly usually reversible effects following continuous or repeated exposures extending over days, months, or years. The extent of the exposure may be great or small.

In general, those substances classified as having "slight toxicity" produce changes in the human body which are readily reversible and which will disappear following termination of exposure, either with or without medical treatment.

2 = Moderate Toxicity

(a) *Acute local.* Materials which on single exposure lasting seconds, minutes, or hours cause moderate effects on the skin or mucous membranes. These effects may be the result of intense exposure for a matter of seconds or moderate exposure for a matter of hours.

(b) *Acute systemic.* Materials which can be absorbed into the body by inhalation, ingestion, or through the skin and which produce moderate effects following single exposures lasting seconds, minutes, or hours, or following ingestion of a single dose.

(c) *Chronic local.* Materials which on continuous or repeated exposures extending over periods of days, months, or years cause moderate harm to the skin or mucous membranes.

(d) *Chronic systemic.* Materials which can be absorbed into the body by inhalation, ingestion, or through the skin and which produce moderate effects following continuous or repeated exposures extending over periods of days, months, or years.

Those substances classified as having "moderate toxicity" may produce irreversible as well as reversible changes in the human body. These changes are not of such severity as to threaten life or produce serious physical impairment.

3 = Severe Toxicity

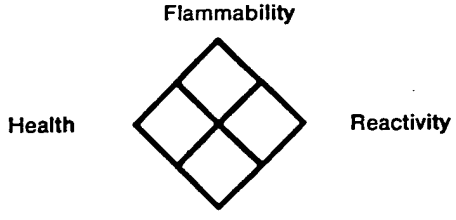
(a) *Acute local.* Materials which on single exposure lasting seconds or minutes cause injury to skin or mucous membranes of sufficient severity to threaten life or to cause permanent physical impairment or disfigurement.

(b) *Acute systemic.* Materials which can be absorbed into the body by inhalation, ingestion, or through the skin and which can cause injury of sufficient severity to threaten life following a single exposure lasting seconds, minutes, or hours, or following ingestion of a single dose.

(c) *Chronic local.* Materials which on continuous or repeated exposures extending over periods of days, months, or years can cause injury to skin or mucous membranes of sufficient severity to threaten life or cause permanent impairment, disfigurement, or irreversible change.

(d) *Chronic systemic.* Materials which can be absorbed into the body by inhalation, ingestion, or through the skin and which can cause death or serious physical impairment following continuous or repeated exposures to small amounts extending over periods of days, months, or years.

Hazard Identification System



The above diagram identifies the "health," "flammability" and "reactivity" (instability and water reactivity) of a chemical and indicates the order of severity of each hazard by use of one of five numerical gradings, from four (4), indicating the severe hazard or extreme danger, to zero (0), indicating no *special* hazard. In the diamond-shaped diagram "health" hazard is identified at the left, "flammability" at the top, and "reactivity" at the right. The bottom space is primarily used to identify unusual reactivity with water. A W with a line through its center W alerts fire fighting personnel to the possible hazard in use of water. This bottom space may also be used to identify a radiation hazard by the symbol ☢. Oxidizing chemicals are identified in the bottom space by OXY.

To supplement the spatial arrangement, NFPA No. 704M recommends the use of colored backgrounds or colored numbers to identify the hazard categories — blue for "health," red for "flammability," yellow for "reactivity."

For a detailed description of the hazard identification system used here, see "Recommended System for the Identification of the Fire Hazards of Materials, NFPA No. 704M, 1969 Edition."

The following paragraphs summarize the meanings of the numbers in each hazard category and explain what a number should tell fire fighting personnel about protecting themselves and how to fight fires where the hazard exists.

Health

4 A few whiffs of the gas or vapor could cause death; or the gas, vapor, or liquid could be fatal on penetrating the fire fighters' normal full protective clothing which is designed for resistance to heat. For most chemicals having a Health 4 rating, the normal full protective clothing available to the average fire department will not provide adequate protection against skin contact with these materials. Only special protective clothing designed to protect against the specific hazard should be worn.

3 Materials extremely hazardous to health, but areas may be entered with extreme care. Full protective clothing, including self-contained breathing apparatus, rubber gloves, boots and bands around legs, arms and waist should be provided. No skin surface should be exposed.

2 Materials hazardous to health, but areas may be entered freely with self-contained breathing apparatus.

1 Materials only slightly hazardous to health. It may be desirable to wear self-contained breathing apparatus.

0 Materials which on exposure under fire conditions would offer no health hazard beyond that of ordinary combustible material.

Flammability

4 Very flammable gases, very volatile flammable liquids, and materials that in the form of dusts or mists readily form explosive mixtures when dispersed in air. Shut off flow of gas or liquid and keep cooling water streams on exposed tanks or containers. Use water spray carefully in the vicinity of dusts so as not to create dust clouds.

3 Liquids which can be ignited under almost normal temperature conditions. Water may be ineffective on these liquids because of their low flash points. Solids which form coarse dusts, solids in shredded or fibrous form that create flash fires, solids that burn rapidly, usually because they contain their own oxygen, and any material that ignites spontaneously at normal temperatures in air.

2 Liquids which must be moderately heated before ignition will occur and solids that readily give off flammable vapors. Water spray may be used to extinguish the fire because the material can be cooled to below its flash point.

1 Materials that must be preheated before ignition can occur. Water may cause frothing of liquids with this flammability rating number if it gets below the surface of the liquid and turns to steam. However, water spray gently applied to the surface will cause a frothing which will extinguish the fire. Most combustible solids have a flammable rating of 1.

0 Materials that will not burn.

Reactivity

4 Materials which in themselves are readily capable of detonation or of explosive decomposition or explosive reaction at normal temperatures and pressures. Includes materials which are sensitive to mechanical or localized thermal shock. If a chemical with this hazard rating is in an advanced or massive fire, the area should be evacuated.

3 Materials which in themselves are capable of detonation or of explosive decomposition or of explosive reaction but which require a strong initiating source or which must be heated under confinement before initiation. Includes materials which are sensitive to thermal or mechanical shock at elevated temperatures and pressures or which react explosively with water without requiring heat or confinement. Fire fighting should be done from an explosion-resistant location.

2 Materials which in themselves are normally unstable and readily undergo violent chemical change but do not detonate. Includes materials which can undergo chemical change with rapid release of energy at normal temperatures and pressures or which can undergo violent chemical change at elevated temperatures and pressures. Also includes those materials which may react violently with water or which may form potentially explosive mixtures with water or generates toxic gases, vapors or fumes when mixed with water. In advanced or massive fires, fire fighting should be done from a protected location.

1 Materials which in themselves are normally stable but which may become unstable at elevated temperatures and pressures or which may react with water with some release of energy but not violently. Caution must be used in approaching the fire and applying water.

0 Materials which are normally stable even under fire exposure conditions and which are not reactive with water. Normal fire fighting procedures may be used.

Browning-Ferris Industries

CHEMICAL WASTE SYSTEMS

BFI Waste Code No. _____

EPA Generator Id. No. _____

EPA Waste Code No. _____

WASTE CHARACTERIZATION DATA

General Directions: In order for us to determine whether we can lawfully and safely transport, treat, and dispose of your waste material, we must obtain certain information about the chemical and physical properties of the waste and its chemical composition. Please be complete in your answers; if your response is "none" or "not available", so indicate. Answers must be printed in ink or typewritten and the completed form must be signed. Please make a copy of this form for your records.

(1.) Generator Name: _____ Date _____

(2.) Generating Facility Complete Address

_____

(3.) Authorized Company Representative: _____ Title: _____

(4.) Phone Number: _____

(5.) Emergency Contact _____ Title _____ Phone Number: _____

(6.) General Description of The Waste: _____

_____

(7.) Process Generating Waste: _____

(8.) Anticipated volume _____ [ ] Gallons [ ] Tons [ ] Cubic Yards [ ] Drums, or [ ] Other _____

Per: [ ] Day [ ] Week [ ] Month [ ] Year, or [ ] Other _____

(9.) Waste Properties:

(a.) Vapor pressure (in mm of Hg @ 25 °C) _____

(b.) Flash Point _____ [ ] °F [ ] °C [ ] Closed Cup [ ] Open Cup

(c.) Phases/layers: [ ] Single [ ] Bilayered [ ] Multilayer

(d.) Physical State @ 20 °C: [ ] Solid [ ] Liquid [ ] Semi Solid [ ] Powder [ ] Other _____

(e.) Solubility (g/100 g H_2O) @ 20 °C: _____

(f.) pH _____

(g.) Density: _____ [ ] lb./ft.³ [ ] lb./gal. [ ] Other _____

(h.) Odor: [ ] Strong [ ] Mild [ ] None

(j.) Reactivity

Hydrophoric [ ] Yes [ ] No Autopolymerizable [ ] Yes [ ] No Shock Sensitive [ ] Yes [ ] No

Pyrophoric [ ] Yes [ ] No Thermally Sensitive [ ] Yes [ ] No Explosive [ ] Yes [ ] No

(10.) Complete waste composition (with ranges – indicate % or ppm.) Attach Additional Pages if Necessary

ORGANIC INORGANIC

_____

_____

_____

_____

(11.) Required marking, labeling, and placarding ☐ Flammable ☐ Combustible ☐ Poison A ☐ Poison B ☐ Corrosive ☐ Oxidizer

(12.) Sample Included ☐

(13.) Does this waste contain biological materials, pathogens or etiological agents? _____ If yes, please specify.

(14.) Have you obtained toxicity studies of this waste material? _____ If so, please attach a copy of the results.

(15.) Required personnel protective equipment & procedures. (Please attach additional pages if necessary.)

I hereby certify that the above and attached description is complete and accurate to the best of my knowledge and ability to determine, that no deliberate or willful omissions of composition or properties exists, and that all known or suspected hazards have been disclosed.

Generator's Authorized Signatory

_____ Title _____ Date _____

Confidentiality Agreement: As consideration for the Generator's release of the above information and any other supplemental data, the undersigned agrees to treat such information as confidential property and will not disclose such information to others except as is required by law, and in such circumstances only after first giving notice to the Generator.

By _____ _____

Name Title

BFI Houston Lab Distributes:

DISPOSAL SITE - white copy TRANSPORTATION - green copy LAB - pink copy REGIONAL OFFICE - yellow copy SALES OFFICE - gold copy

a range of disposal fees of $0.01 to $0.06 per pound of solid waste and $0.06 to $0.72 per gallon of liquids and sludges. Assuming that 650,000 cubic yards of Basin F material need to be disposed of, the disposal fees, if solidified, would range between 22 million dollars and 134 million dollars. This assumes that the disposed solid weighs 127 pounds per cubic foot. If the Basin F material is transported for disposal as is, that is both liquid from the basin and bottom solids and liner, an additional cost would be incurred for the liquid portion. It is estimated that Basin F, at the time of final closure, will contain approximately 12 million gallons of liquid. This would increase disposal fees from about $720,000 to $8,640,000. Transportation costs are estimated based on a ton per mile or cubic yard per mile basis. The transportation rate for hauling fill dirt is about $0.13 per ton mile. In a previous RMA report, as well as estimates by the EPA, transporting hazardous wastes costs at least $0.30 per cubic yard per mile. If this waste were transported to the Browning-Ferris Last Chance site, a distance of approximately 60 miles, transportation costs could vary between about 8.7 million dollars and 11.7 million dollars.

On-site disposal costs would include constructon of the disposal cells, treatment and handling cost, monitoring requirements, operating and maintenance costs, and closure costs. It is likely that the treatment and handling would be the same whether disposal is on-site or off-site. The principal cost for on-site would be landfill

construction, monitoring systems and operations costs during disposal. Once the wastes have been disposed and the facility closed, the long-term monitoring costs would be minimal. Previous estimates for on-site disposal of RMA, including landfill construction, waste solidification and emplacement, monitoring systems and cell closure, have been estimated at between about 14 million dollars and 20 million dollars.

B. Site Selection Criteria

The goal of a hazardous waste landfill facility is secure burial that will achieve long-term isolating of hazardous wastes from the environment. There are certain minimal physical criteria, including hydrologic, geologic, hydrogeologic and topographic considerations, that need to be addressed in determining the adequacy of a proposed site for utilization as a hazardous waste landfill site. In general, surface and ground water should be precluded from coming in contact with the buried wastes. Any leachate generated from the wastes must be prevented from migrating into the surrounding environment. The natural conditions existing at a landfill site should be such that minimal long-term maintenance is required.

To the extent that a proposed site does not meet minimal, natural criteria, a safe landfill can still be constructed with careful enginering. Although an ideal natural site might be found suitable for hazardous waste disposal, it may not be in the location where its

utility could be realized. Therefore, the selection of a site is necessarily a combination of the natural setting and engineering required to make the site suitable. Certainly, any site could be engineered for a hazardous waste disposal site, but the site that would require the least amount of engineering would be the most preferable.

1. Topography

Topography considerations in selecting a suitable hazardous waste landfill generally deal with slope and relief. Favorable areas are those where slopes are level to nearly level. Slopes of less than three per cent are preferred. The area should have little relief in order to minimize concentrating runoff along defined channels. Depression where water can accumulate are to be avoided because these may result in ponding of surface water that can then be a hydraulic head source for leachate generation or surface erosion. Essentially, surface topographic conditions should be such that precipitation run-on and runoff can be minimized.

2. Surface Hydrology

Surface hydrology considerations generally deal with the proximity of a site of a perennial stream or body of standing water. The site should be sufficiently far from a stream or lake that, should runoff occur, the runoff under normal conditions would not reach these water bodies either through overland flow or base flow through the unsaturated zone.

Flooding potential of site also needs to be considered. The site must not be located within the 100-year floodplain of an active stream. The area that might be inundated under the probable maximum flood shoud be determined. Under ideal conditions, a hazardous waste landfill site should be located outside that zone.

3. Geology

Geologic conditions that occur within the immediate vicinity of a proposed landfill facility need to be thoroughly examined. The lithologic characteristics and stratigraphic relationships of the underlying sediment and/or rock must be known. Geologic hazards, such as faulting, seismic activity, unstable slopes and ground subsidence also must be evaluated.

With respect to lithology at the burial medium, it is desirable that it have low permeability characteristics. The lower the permeability of the disposal medium, the greater the ability of that medium to impede migration of possible leachates. Shale and clay as a disposal medium is desirable for two reasons: (1) this type of sediment has very low intrinsic permeability (less than 10^{-7} to 10-9 cm/sec), thereby providing an effective barrier to fluid migration; and (2) in addition, clayey materials can, in many instances, effectively absorb ions present within the waste material. This ion exchange capacity can further reduce any contaminant transport that might occur.

The distribution of lithologic discontinuities need to be determined. For example, interbedded sand units within shale or clay units may affect migration of fluids. This migration may be enhanced not only because of the presence of higher permeability sediments, but also along the lithologic contents. This may not, however, be much of a problem if the degree of interconnection among these sand leases is restricted.

If a fault occurs within the geologic units underlying a proposed site, its relative age needs to be determined. This will provide a basis for determining what the potential for future structural movements might occur.

A hazardous waste landfill should be located in an area of low seismic risk. Seismic activity might be severe enough to cause a rupture of the cell liner, thereby allowing for potential fluid migration from the landfill into the surrounding environment. If seismic activity is known to occur, however, proper engineering design and waste disposal practices can be employed to mitigate seismic risk.

4. Hydrogeology

Hydrogeologic considerations in siting a hazardous waste landfill facility revolve principally around the groundwater flow regime that exists within the vicinity of the site. Such factors as location and distribution of aquifers, groundwater and surface water/groundwater interactions are all part of the evaluation process. Probably, at

more significance in evaluating a potential site is the nature of the aquicludes, or confining beds, that separate the water bearing strata.

The thickness and permeability of confining beds are of principal importance in locating a waste facility. The permeability of the in place underlying confining bed should be at least 10^{-7} cm/sec and thick enough to prevent possible migration of hazardous liquids to an aquifer. The rule of thumb, at least in Colorado, has been that the confining bed should be of proper thickness and permeability to prevent movement of hazardous waste liquids into a known aquifer for at least 1,000 years. However, the flow regime that exists in and around a site may modify this requirement.

The direction of groundwater flow, or the distribution of potentiometric heads, underlying a site plays a significant role in determining the adequacy of a site. An area in which groundwater flow components are upward underneath a site certainly modifies the aquiclude thickness and permeability requirements. Even if leachate were to be generated in a cell within a landfill, the leachate would not migrate towards an underlying aquifer. If upward flow components were of sufficient magnitude to provide measurable quantities of groundwater, there is a potential that surface seeps may occur. This might result in hazardous leachates appearing at the surface. However, proper landfill design, including leachate collection systems and head dissipation networks, would mitigate this concern.

C. Evaluation of Proposed Site

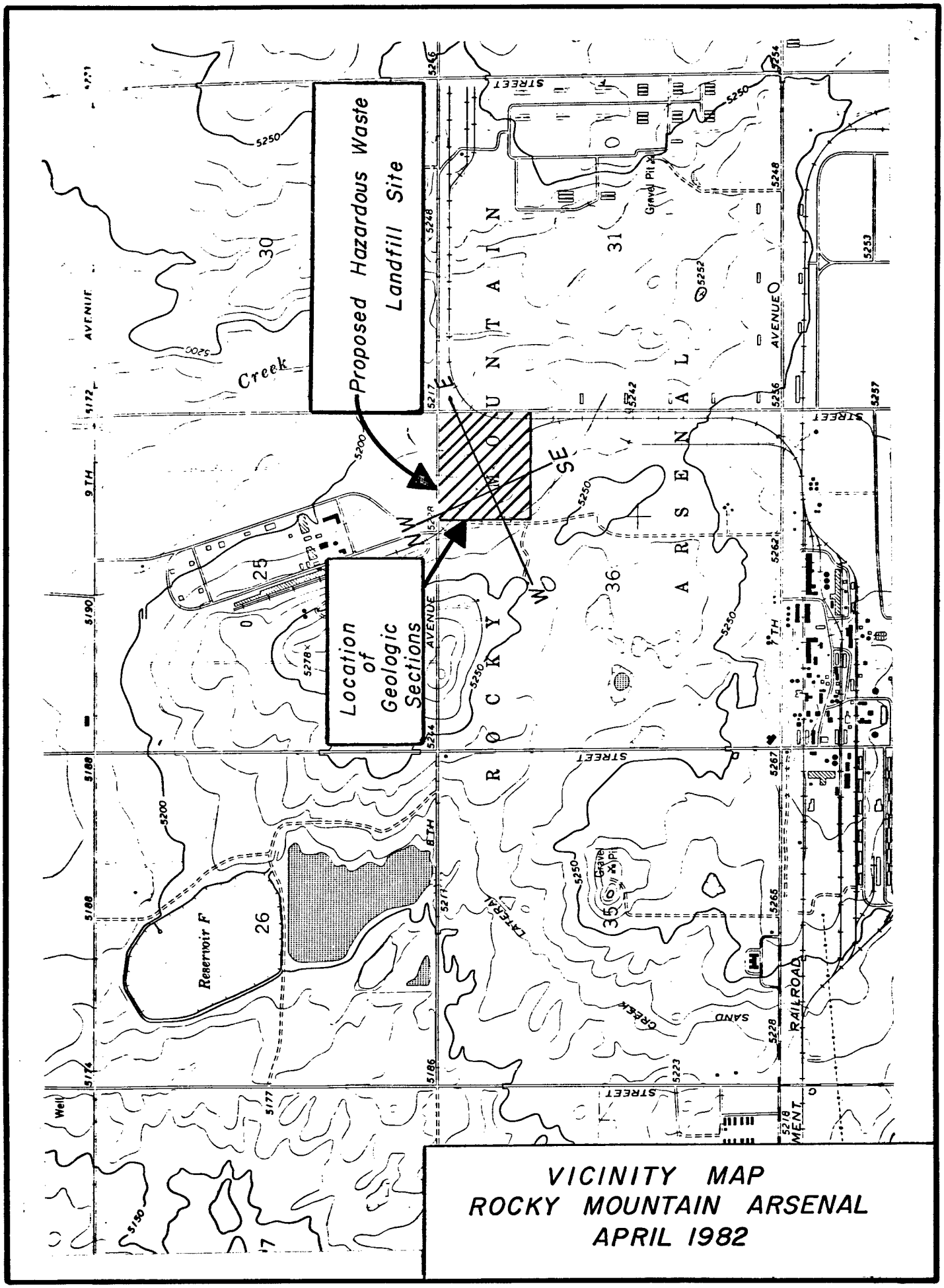
Based on the site selection criteria described above, this section deals with the evaluation on an area in Section 36 at RMA as to its suitability for construction of, and utilization as, a hazardous waste landfill disposal site. The minimum area under consideration covers approximately 35 acres.

1. Location and Size

The proposed hazardous waste landfill site is located in the NE1/4 of the NE1/4 of Section 36, Township 25, Range 67 West in the central part of Rocky Mountain Arsenal (Figure II.1). Numerous testholes have been drilled in the vicinity to provide basic geotechnical information. The area under consideration is bounded by 8th Avenue on the north, boring AP-4 on the west, boring AP-5 on the south and E Street on the east. This covers an area of approximately 60 acres of which only about half will be required for actual waste disposal.

The actual size of the hazardous waste landfill facility will depend on the size and depth of the individual waste cells, and the volume of waste from Basin F to be disposed. It is assumed that the cells will not be more than 30 feet deep and that approximately 650,000 cubic yards of solidified in Basin F material will be disposed. This will require approximately 20 acres for disposal. Allowing additional space for access roads, ancillary facilities and a buffer zone, it is estimated that the total size of this hazardous waste landfill will be approximately 35 acres.

FIGURE II.1



VICINITY MAP
ROCKY MOUNTAIN ARSENAL
APRIL 1982

2. Topography

The ground surface in the vicinity of the proposed landfill site is an area of little relief sloping in a northeasterly direction at less than two per cent. Elevations within the area ranges from approximately 5,240 feet to less than 5,220 feet (mean sea level). Immediately west of the proposed site, elevations rise to crest at an elevation of approximately 5,290 feet, about one-half mile away. The general northeasterly slope is towards the intermittent First Creek, somewhat greater than one-quarter of a mile east of the proposed site. A diversion ditch parallels the north-south road traversing the eastern half of Section 36 in the area of interest. Otherwise there are no notable drainage features within the vicinity of the proposed sites.

3. Surface Hydrology

The only significant drainage feature that occurs in the area is First Creek. This creek, draining northward, is classified as intermittent at its closest point to the proposed site in Section 31. Approximately in the northwest quarter of Section 30, First Creek becomes a perennial stream. This is a distance in excess of one-half mile from the probable closest point of the proposed site.

At present there is no flood data available for this area. The site is definitely not within the present day floodplain of First Creek. In addition, it is unlikely that the site is within the Probable Maximum Flood Zone of First Creek.

4. Geology

The geologic setting within the vicinity of the proposed site is principally a thin veneer of Quaternary to recent sediments overlying the Tertiary and Cretaceous Denver Formation. The younger sediments overlying bedrock range in from less than 3 feet, along the north and west side of the proposed site, to about 17 feet along the south and east side.

The younger sediments are comprised primarily of unconsolidated sand, silt and clay of an alluvial origin. In some places a thin veneer of fine-grained eolian sand occurs at the surface. Generally, the alluvial sediments are classified as silty clays and clayey silts, although some clean, fine-grained sands also occur.

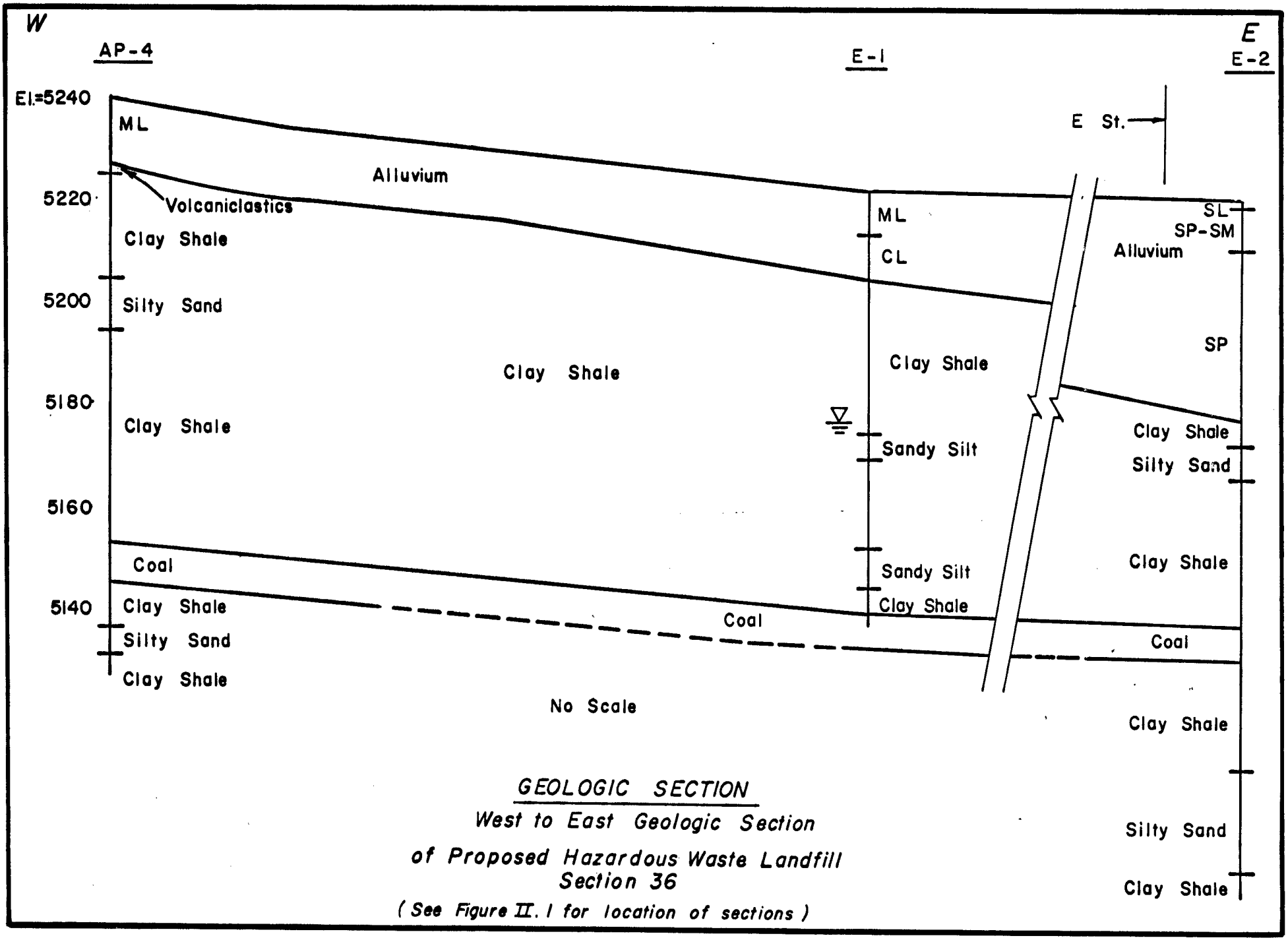
The underlying bedrock, the Denver Formation, consists of sandstone, mudstone, claystone and conglomerates. Over most of Rocky Mountain Arsenal, the Denver Formation is primarily comprised of claystone, shale and clay. It contains numerous minor sandy and silty clay zones and some sand and silt lenses. At depth, these sand lenses are quite thick and their degree of interconnection is complex, requiring a detailed investigation to determine their distribution. Coal seams also ocur within the Denver Formation and can be used as marker beds for stratigraphic correlations. The thickness of the Denver Formation underlying the Arsenal is between about 250 and 400 feet.

The bedrock underlying the proposed site (Figures II.2 and II.3) is comprised almost entirely of clay shale. The lithology varies from a slightly silty clay shale to a sandy clayey silt. Some very fine sand lenses occur at depth, but they do not appear to correlate from boring to boring.

There is little evidence for the existence of any faults underlying the proposed site. It is postulated that a northeasterly trending fault might exist in the southern part of Section 30, east of the proposed site. Whether it extends into Section 36 is not known at this time. However, the fault appears to be only in the Denver Formation and does not extend upward into the younger sediments. Faulting, therefore, does not appear to have occurred much later than the early Tertiary, following deposition of the Denver Formation. This is probably a slump fault, which is quite common in Deltaic environments represented by the Denver Formation.

The proposed landfill site is in an area of low seismic risk. In the past, low magnitude earth tremors have occurred with their epicenters in the Commerce City area. Most of these occurred during a time when the deep injection well was being utilized at RMA. More recently, tremors have occurred in the area, but with no resulting damage.

Other than consideration of faulting and seismic risk, the proposed hazardous waste landfill site does not appear to be subject to



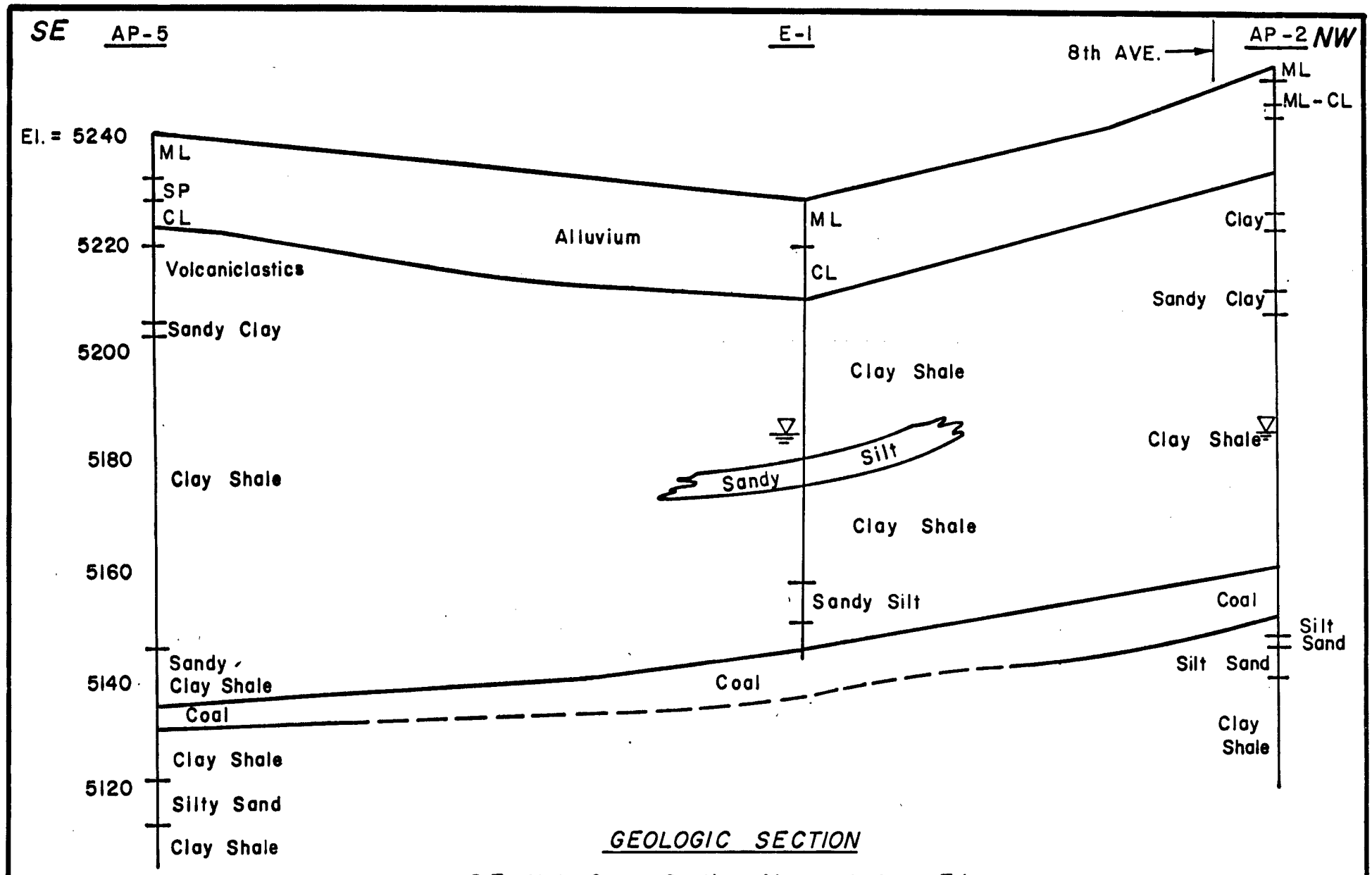
GEOLOGIC SECTION

West to East Geologic Section

of Proposed Hazardous Waste Landfill
Section 36

(See Figure II. 1 for location of sections)

FIGURE II. 2



GEOLOGIC SECTION

SE-NW Cross Section Along Western Edge of Proposed Hazardous Waste Landfill Section 36

(See Figure II.1 for location of sections)

Scale: 1"=25' VERT.
1"=200' HORZ.

FIGURE II.3

any other geologic hazards, such as slope instability, mud flows and flooding.

5. Hydrogeology

The groundwater flow system at RMA consists of primarily two components:

(1) flow through the alluvial system; and,

(2) flow through the bedrock.

In general, groundwater in the bedrock is under artesian conditions, thereby resulting in an upward flow component that contributes groundwater to the alluvial system.

Groundwater flow in the shallow alluvial system generally follows the surface topography. Flow at water through this system is generally from south to north in the vicinity of the proposed site, although no groundwater was actually found in the alluvial materials within the site.

The underlying Denver Formation does, in places, contain significant saturated sand bodies that can supply water to wells and, therefore, this is considered a regional aquifer. However, because of the lithologic variability of this formation, its importance as an aquifer is somewhat limited. A more significant aquifer is in the Arapaho Formation underlying the Denver. This aquifer is separated from the

Denver by a clay shale buffer zone between about 75 and 200 feet thick.

Groundwater does occur in the Denver Formation underneath the proposed site from sand bodies at depth. The water in these fine-grained sands is under artesian conditions, as the piezometric heads are well above the top of these sand units. These artesian conditions underneath the proposed site are significant in the suitability of that site for hazardous waste disposal.

If any leachate were to be generated and even if a leak does occur at the disposal site, the artesian conditions in the Denver Formation would preclude the migration of hazardous fluids from migrating through the Denver aquifer. Leachate would be restricted to migrating through the near surface alluvial materials, where they can be much more easily monitored and contained.

The rates and quantity of fluids migrating through alluvial sediments and bedrock materials are principally a function of the hydraulic conductivity characteristics of these sediments. In addition, the geochemistry at the clays can also play a significant role in retarding leachate movement.

The hydraulic conductivity of the alluvial materials underlying the proposed site is quite variable because of the variability of the sediments. Pump test in wells completed in alluvium of RMA indicate a range of hydraulic conductivity between about 7×10^{-3} cm/sec to 9 X

10^{-1} cm/sec. Within the proposed site, it would be expected that the hydraulic conductivity of the alluvial materials would be toward the low end because of the generally clayey nature of these sediments.

The hydraulic conductiviy of the Denver Formation will also be quite variable depending on the lithologic unit. Pumping and slug tests of the sandier units of the Denver Formation yield values in the 10^{-3} to 10^{-4} cm/sec range. The clay portions of this formation would be expected to have hydraulic conductivities of less than 10^{-7} cm/sec.

The clay content of the alluvial sediments and the bedrock will also be significant in controlling any potential leachate migration. The clays in these units are generally montmorrillonitic and have a high ion exchange capacity. It is likely that any leachate generated that might enter the natural system would be quickly attenuated by this ion exchange mechanism.

In summary, the hydrogeologic setting of the proposed site makes it suitable for locating and operating a hazardous waste landfill site because of:

(1) the restricted hydraulic conductivities of the underlying sediments;

(2) the ion exchange capacity of the clays; and,

(3) the groundwater flow regime that restricts migration of fluids within and away from the sites.

D. Design Criteria for Hazardous Waste Disposal Site

1. General

The design of a hazardous waste landfill facility is aimed at preventing the release of hazardous materials to the environment. With respect to the disposal of Basin F materials at the proposed site in Section 36, these criteria are assumed to be geotechnical in nature. It is assumed that, because of the solidification process to be used, contamination by air transport or gaseous emanatons are not of concern. Therefore, the considerations for isolating these materials from environment deal with potential groundwater and surface water contamination by migration of free liquids and generated leachates. With respect to free liquids, the solidification of Basin F sludge should not produce any.

Leachates that might be generated need a liquid source, either that are inherently present in the waste material or liquid contribution from a groundwater source or surface water source largely due to precipitation infiltration.

The use of appropriate liners, diversions and cover material then becomes the principal factors in minimizing leachate generation within a landfill site. A monitoring system is a basic requirement in determining if leachate is being generated and, if so, how much and whether or not it is migrating. Another component, then, is to provide a system for removing any leachate that might be generated. In general,

the following componenets are part of a hazardous waste landfill system:

(1) Infiltration Control System;

(2) Monitoring and Control System;

(3) Seepage Control System;

(4) Cell Dimensions; and,

(5) Cell Closure.

2. Infiltration Control System (ICS)

The ICS is designed to minimize rainfall infiltration and surface runoff from the system. This requires that a runoff control system be constructed upslope and around each cell to divert storm runoff from the disposal area. The cell should be of a size that will allow covering at frequent enough intervals so that precipitation inflow into the cell is held at a minimum. Finally, the cell cover should be of sufficient thickness (approximately 4 feet) to prevent deep percolation at rainfall. This cover needs to slope from the center outward, so ponding on top of the cell cannot occur.

3. Monitoring Control System

The major component of this system is to provide for dissipation of any hydrostatic heads that may build up within a waste cell and a method of recovery for any generated leachates. This will necessitate installing a one-foot sand or sand and gravel layer between the underlying clay liner and the waste material.

This sand layer should be sloped at 2 percent toward the center and to a side of the cell where a recovery sump will be installed. Collection pipes of sufficient diameter (6 inches) will extend from this sump to the ground surface to provide access to these sumps.

Beneath the first clay liner, another clay liner, separated by a one-foot sand layer will also be installed. This second sand layer will have the same slope and sump requirements as the first sand layer. It will serve as a leachate detection system that will provide a warning that migration is occurring.

The second clay liner will serve as a back-up leachate control system.

Each cell will require a network of observation wells to continuously monitor the groundwater regime. The depth and location of these wells will depend on the actual site conditions. However, at minimum, it will be located around the cell equal to the depth of the bottoms of the sand collectors, at the water table in the alluvium, should one exist, and at the first continued water body underlying the cell. It is assumed that gaseous by-products will not be generated so gas venting wells will not be required to be installed in the cell itself.

The cell itself will be constructed using a double liner system for seepage control, as described above. It is anticipated that the chemical nature of the Basin F waste material will have no adverse

reaction with natural clays. The liner, therefore, can be constructed of compacted clay or a clay mixture with a maximum hydraulic conductivity of 10^{-7} cm/sec. Each cell will be completely enclosed by the liner.

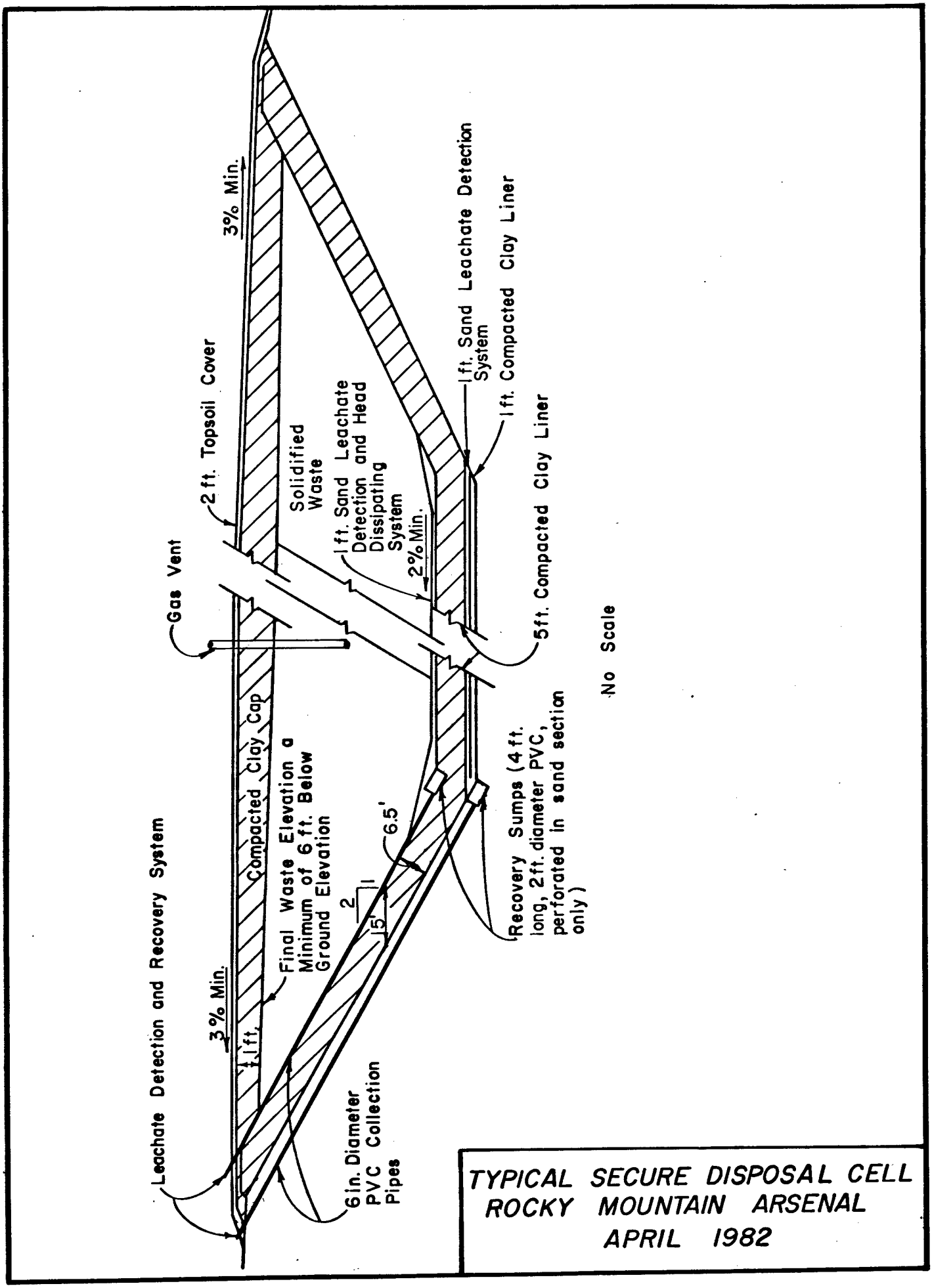
The upper liner should have a bottom thickness of at least 5 feet. The underlying secondary liner should be at least 1 foot thick and be emplaced under the floor of the primary liner. The walls of the liner should not exceed a slope of 2 to 1.

The cell dimensions will depend on how much waste material is disposed of during a given period of time, the total quantity of waste, the potential amount of precipitation inflow and type of equipment used. The size of the cell, at least in one dimension, will be limited to the type of equipment to be used for emplacing the waste so as to insure liner integrity. The same will hold true should the waste material be required to be removed from a cell and still maintain liner integrity. Spacing between cells needs to be sufficient for safe and efficient movement of operating equipment as well as emergency vehicles.

4. Final Cover

The cover of each cell should be at least 4 feet thick and composed of compacted clay or clay mixture, sloped from the center outward as described above. A final topsoil cover of at least 2 feet is to be emplaced over that cover and vegetation to be established. Deep rooting vegetation is to be avoided.

FIGURE II.4



TYPICAL SECURE DISPOSAL CELL
ROCKY MOUNTAIN ARSENAL
APRIL 1982

III. REGULATORY REVIEW

A. General

The construction and operation of a hazardous waste landfill facility is subject to numerous Federal, State and County regulations. The hazardous wastes at RMA are subject to regulation principally under the Resource Conservation and Recovery Act of 1976 (RCRA). Colorado Senate Bill 519, concerning management and disposition of solid and hazardous waste, at present is only concerned with off-site disposal. However, should Colorado receive authority to regulate on-site disposal of hazardous wastes, the requirements of such disposal will be at least as stringent as these for off-site disposal under the S.B. 519 regulations. Therefore, these present State regulations should be considered and addressed in the evaluation of on-site hazardous waste disposal. Regulations developed under other Federal and State laws, such as the Clean Air Act, Colorado Air Pollution Control Act, and Colorado Water Quality Control Act, also have limited applicability under certain conditions. However, the RCRA and S.B. 519 regulations generally include the requirements of these other regulations. Therefore, permitting a hazardous waste landfill facility under RCRA and S.B. 519 will satisfy the necessary legal requirements of other environmental quality control laws.

At present, on-site hazardous waste disposal facilities are not regulated by Colorado. Only the regulations adopted and administered

by the Environmental Protection Agency (EPA) apply. The State regulations, as administered by the Colorado Department of Health, apply only to off-site facilities. It is not anticipated by that Department that the regulation of on-site facilities will be in place prior to about April, 1982. However, as it is the purpose of EPA to turn enforcement authority over to the States, it is essential that the State Department of Health be included throughout the permit application process.

In dealing with the applicability of State and Federal regulations, it must be kept in mind that, in all instances, the Federal regulations will be the minimum standards. States may develop their own set of regulations which may be more stringent but, in no case, may they be any less restrictive than the Federal regulations. Therefore, if an RMA permitted on-site hazardous waste landfill under EPA's RCRA regulations is developed, it should satisfy the State of Colorado's regulations should they come into effect in the interim.

A review of the present State regulations for siting, construction and operation of an off-site hazardous waste facility match those requirements under 40CFR267 of the Federal regulations. It is likely then that the State will adopt a similar stance for on-site hazardous waste facilities.

The specific regulations reviewed for this investigation are, principally, those adopted and administered by the Environmental

Protection Agency (EPA). In addition, some EPA promulgated regulations are under the administrative and enforcement control of the State through cooperative agreements. The Federal regulations applicable to a hazardous waste management system for on-site disposal are listed below:

Reference	Title
40CFR260	Hazardous Waste Management Systems: General
40CFR261 (and 261 Amended)	Identification and Listing of Hazardous Waste
40CFR262	Standards Applicable to Generation of Hazardous Waste
40CFR264	Standards Applicable to Owners and Operators of Hazardous Waste Treatment, Storage and Disposal Facilities
40CFR265	Interim Status Standards Applicable to Owners and Operators of Hazardous Waste Treatment, Storage and Disposal Facilities
40CFR122	Permits for Treatment, Storage and Disposal
40CFR267	Interim Standards for Owners and Operators of New Hazardous Waste Land Disposal Facilities

Colorado regulations, that may be applicable to the operation and maintenance of a hazardous waste disposal facility, are under the jurisdiction of the Colorado Department of Health rules and regulations pertaining to solid and hazardous wastes, promulgated under Title 25, Article 15, CRS1973, as amended. Regulations under 26-34

(CRS1963), pertaining to solid waste disposal sites and facilities, 66-38, pertaining to water pollution control, and regulations under Article 1, Title 25 (CRS1973), pertaining to primary drinking water standards, have some overlapping requirements with respect to a hazardous waste management facility.

There are no specific County regulations affecting hazardous waste disposal other than that the owner/operator is required to obtain a certificate of designation from the Board of County Commissioners. The State and Federal hazardous waste regulations must be satisfied in order to obtain this certificate.

B. Regulatory Requirements

1. General

Regulations applicable to permitting and operating a hazardous waste landfill facility at RMA fall, essentially, into two broad categories: (1) administrative; and (2) technical. The administrative requirements generally deal with facility standards, operating plans, record keeping, personnel training, reporting, and emergency contingency planning. The technical standards generally relate to minimum performance standards, environmental considerations, general operating requirements, monitoring requirements and facility closure and post-closure.

This section summarizes the regulations and highlights key points of the various Federal and State regulations. Where appropriate, specific sections of the regulations are reproduced.

2. Federal Regulations

The primary regulations relating to a hazardous waste disposal facility are contained within 40CFR264, 265 and 267. Regulations under 40CFR264 include the first phase standards which will be used to issue permits. Included are requirements with respect to preparedness for, and prevention of hazards, contingency planning and emergency procedures, the manifest system, record keeping and reporting. Also included are general requirements with respect to identification numbers, required notices, waste analysis, security at facilities, inspection of facilities and personnel training. Regulations under 40CFR265 include the interim standards under Part 264, including the general requirements of that part as well as specific requirements for groundwater monitoring, facility closure, post-closure care, financial requirements, and design and operation of landfills. The regulations under 40CFR267 include technical standards for permitting a landfill facility that specify certain minimum design and operating criteria.

40CFR260 - These regulations define terms, general standards and overview information applicable to Parts 260 through 267.

40CFR261 (and 261 Amended) - This part identifies those solid wastes which are classified as hazardous and subject to RCRA

regulations. Section 261.3 defines a hazardous waste, while Sections 261.11 through 261.24 outline the criteria for characterizing a hazardous waste, as well as the criteria for listing materials as hazardous.

The waste material, both liquid and soils, from Basin F were analyzed for the hazardous characteristics of ignitability (Section 261.21), corrosivity (Section 261.22), reactivity (Section 261.23 and EP toxicity (Section 261.24). This waste material only failed the EP toxicity test and is, therefore, classified as hazardous (see Table 1).

Table 1

Maximum Concentration of Contaminants for Characteristics of EP Toxicity

Contaminant	Maximum Concentration (mg/l)	Basin F Fluid	Basin F Soil
Arsenic	5.0	<	<
Barium	100.0	<	<
Cadmium	1.0	<	<
Chromium	5.0	<	<
Lead	5.0	<	<
Mercury	0.2	<	<
Selenium	1.0	2.6	<
Silver	5.0	<	<
Endirin	0.02	<	0.072
Lindane	0.4		
Methoxychlor	10.0		
Toxaphene	0.5		
2-4-D	10.0		
2-4-TP	1.0		

40CFR264 - This part establishes the minimum national standards

with respect to hazardous waste management. Subpart A defines the applicability of these regulations to owners and operators of hazardous waste facilities. Subpart B (264.10 through 264.29) describes the general facility standard requirements. Section 264.13 requires that the owner/operator undertake a complete chemical and physical analysis of waste (40CFR261 - Identification of Hazardous Wastes) prior to disposal. Section 264.13(b) requires a waste analyses plan which includes the parameters to be analyzed, test methods to be followed and sampling procedure.

Section 264.14 deals with providing security for a hazardous waste disposal facility, particularly restricting access to the active portion of the facility. The present security operations in effect at RMA would appear to satisfy the requirements of this Section.

The owner/operator must develop an inspection and monitoring schedule under Section 264.15 for malfunctions, deteriorations, operator errors, and discharges which may result in a hazardous waste discharge to the environment or a threat to human health. This section also outlines the requirements for maintaining the inspection records for a minimum of three years from the date of each inspection.

Section 264.16 deals with training of personnel who will be working on the facility and provides for classroom as well as on-the-job training.

Subpart C of Part 264 deals with preparedness and prevention. It requires that the design and operation of a hazardous waste facility

§ 264.13 General waste analysis.

(a) (1) Before an owner or operator treats, stores, or disposes of any hazardous waste, he must obtain a detailed chemical and physical analysis of a representative sample of the waste. At a minimum, this analysis must contain all the information which must be known to treat, store, or dispose of the waste in accordance with the requirements of this Part or with the conditions of a permit issued under Part 122, Subparts A and B, and Part 124 of this Chapter.

(2) The analysis may include data developed under Part 261 of this Chapter, and existing published or documented data on the hazardous waste or on hazardous waste generated from similar processes.

[*Comment:* For example, the facility's records of analyses performed on the waste before the effective date of these regulations, or studies conducted on hazardous waste generated from processes similar to that which generated the waste to be managed at the facility, may be included in the data base required to comply with paragraph (a)(1) of this Section. The owner or operator of an off-site facility may arrange for the generator of the hazardous waste to supply part or all of the information required by paragraph (a)(1) of this Section. If the generator does not supply the information, and the owner or operator chooses to accept a hazardous waste, the owner or operator is responsible for obtaining the information required to comply with this Section.]

(3) The analysis must be repeated as necessary to ensure that it is accurate and up to date. At a minimum, the analysis must be repeated:

(i) When the owner or operator is notified, or has reason to believe, that the process or operation generating the hazardous waste has changed; and

(ii) For off-site facilities, when the results of the inspection required in paragraph (a)(4) of this Section indicate that the hazardous waste received at the facility does not match the waste designated on the accompanying manifest or shipping paper.

(4) The owner or operator of an off-site facility must inspect and, if necessary, analyze each hazardous waste movement received at the facility to determine whether it matches the identity of the waste specified on the accompanying manifest or shipping paper.

(b) The owner or operator must develop and follow a written waste analysis plan which describes the procedures which he will carry out to comply with paragraph (a) of this Section. He must keep this plan at the facility. At a minimum, the plan must specify:

(1) The parameters for which each hazardous waste will be analyzed and the rationale for the selection of these parameters (i.e., how analysis for these parameters will provide sufficient information on the waste's properties to comply with paragraph (a) of this Section);

(2) The test methods which will be used to test for these parameters;

(3) The sampling method which will be used to obtain a representative sample of the waste to be analyzed. A representative sample may be obtained using either:

(i) One of the sampling methods described in Appendix I of Part 261 of this Chapter; or

(ii) An equivalent sampling method.

[*Comment:* See § 261.20(c) of this Chapter for related discussion.]

(4) The frequency with which the initial analysis of the waste will be reviewed or repeated to ensure that the analysis is accurate and up to date; and

(5) For off-site facilities, the waste analyses that hazardous waste generators have agreed to supply.

(c) For off-site facilities, the waste analysis plan required in paragraph (b) of this Section must also specify the procedures which will be used to inspect and, if necessary, analyze each movement of hazardous waste received at the facility to ensure that it matches the identity of the waste designated on the accompanying manifest or shipping paper. At a minimum, the plan must describe:

(1) The procedures which will be used to determine the identity of each movement of waste managed at the facility; and

(2) The sampling method which will be used to obtain a representative sample of the waste to be identified, if the identification method includes sampling.

[*Comment:* Part 122, Subpart B, of this Chapter requires that the waste analysis plan be submitted with Part B of the permit application.]

§ 264.55 Emergency coordinator.

At all times, there must be at least one employee either on the facility premises or on call (i.e., available to respond to an emergency by reaching the facility within a short period of time) with the responsibility for coordinating all emergency response measures. This emergency coordinator must be thoroughly familiar with all aspects of the facility's contingency plan, all operations and activities at the facility, the location and characteristics of waste handled, the location of all records within the facility, and the facility layout. In addition, this person must have the authority to commit the resources needed to carry out the contingency plan.

[*Comment:* The emergency coordinator's responsibilities are more fully spelled out in § 264.56. Applicable responsibilities for the emergency coordinator vary, depending on factors such as type and variety of waste(s) handled by the facility, and type and complexity of the facility.]

§ 264.56 Emergency Procedures.

(a) Whenever there is an imminent or actual emergency situation, the emergency coordinator (or his designee when the emergency coordinator is on call) must immediately:

(1) Activate internal facility alarms or communication systems, where applicable, to notify all facility personnel; and

(2) Notify appropriate State or local agencies with designated response roles if their help is needed.

(b) Whenever there is a release, fire, or explosion, the emergency coordinator must immediately identify the character, exact source, amount, and areal extent of any released materials. He may do this by observation or review of facility records or manifests, and, if necessary, by chemical analysis.

(c) Concurrently, the emergency coordinator must assess possible hazards to human health or the environment that may result from the release, fire, or explosion. This assessment must consider both direct and indirect effects of the release, fire, or explosion (e.g., the effects of any toxic, irritating, or asphyxiating gases that are generated, or the effects of any hazardous surface water run-off from water or chemical agents used to control fire and heat-induced explosions).

(d) If the emergency coordinator determines that the facility has had a release, fire, or explosion which could threaten human health, or the environment, outside the facility, he must report his findings as follows:

(1) If his assessment indicates that evacuation of local areas may be advisable, he must immediately notify appropriate local authorities. He must be available to help appropriate officials decide whether local areas should be evacuated; and

(2) He must immediately notify either the government official designated as the on-scene coordinator for that geographical area, (in the applicable regional contingency plan under Part 1510 of this Title) or the National Response Center (using their 24-hour toll free number 800/424-8802). The report must include:

(i) Name and telephone number of reporter;

(ii) Name and address of facility;

(iii) Time and type of incident (e.g., release, fire);

(iv) Name and quantity of material(s) involved, to the extent known;

(v) The extent of injuries, if any; and

(vi) The possible hazards to human health, or the environment, outside the facility.

(e) During an emergency, the emergency coordinator must take all reasonable measures necessary to ensure that fires, explosions, and releases do not occur, recur, or spread to other hazardous waste at the facility. These measures must include, where applicable, stopping processes and operations, collecting and containing release waste, and removing or isolating containers.

(f) If the facility stops operations in response to a fire, explosion, or release, the emergency coordinator must monitor for leaks, pressure buildup, gas generation, or ruptures in valves, pipes, or other equipment, wherever this is appropriate.

(g) Immediately after an emergency, the emergency coordinator must provide for treating, storing, or disposing of recovered waste, contaminated soil or surface water, or any other material that results from a release, fire, or explosion at the facility.

(h) The emergency coordinator must ensure that, in the affected area(s) of the facility:

(1) No waste that may be incompatible with the released material is treated, stored, or disposed of until cleanup procedures are completed; and

(2) All emergency equipment listed in the contingency plan is cleaned and fit for its intended use before operations are resumed.

Section 264.55 Emergency Coordinator
Section 264.56 Emergency Procedures

(i) The owner or operator must notify the Regional Administrator, and appropriate State and local authorities, that the facility is in compliance with paragraph (h) of this Section before operations are resumed in the affected area(s) of the facility.

(j) The owner or operator must note in the operating record the time, date, and details of any incident that requires implementing the contingency plan. Within 15 days after the incident, he must submit a written report on the incident to the Regional Administrator. The report must include:

(1) Name, address, and telephone number of the owner or operator;

(2) Name, address, and telephone number of the facility;

(3) Date, time, and type of incident (e.g., fire, explosion);

(4) Name and quantity of material(s) involved;

(5) The extent of injuries, if any;

(6) An assessment of actual or potential hazards to human health or the environment, where this is applicable; and

(7) Estimated quantity and disposition of recovered material that resulted from the incident.

minimize the potential for a violent, sudden, or nonsudden release of hazardous material to the environment. Appropriate alarm systems, fire protection and spill control equipment must be maintained and available in the event of an emergency.

Subpart D (Sections 264.50 through 264.69) deals with the development of an action plan to handle any emergency situation that may affect human health or result in an unplanned release of hazardous materials to the environment. An emergency coordinator (Section 264.55) must be on call at all times. These regulations also describe the action the emergency coordinator must take in the event of imminent or actual emergency situations.

Subpart E of these regulations generally deals with the use of a manifest system, record keeping and reporting. As RMA will have an on-site facility and will not accept any off-site hazardous wastes, most of this subpart is not applicable. Section 264.73, however, requires that the owner/operator keep a written record of facility operations, including waste quantities and descriptions, cell locations, waste analyses, and summary reports of incidents under Section 264.56 (contingency plan). Sections 264.74 and 264.75 are also applicable in that they deal with record retention and annual reports to the EPA regional administration.

40CFR265 - These regulations are essentialy the interim standards based on Part 264 and are applicable to owners/operators of hazardous

§ 264.73 Operating record.

(a) The owner or operator must keep a written operating record at his facility.

(b) The following information must be recorded, as it becomes available, and maintained in the operating record until closure of the facility:

(1) A description and the quantity of each hazardous waste received, and the method(s) and date(s) of its treatment, storage, or disposal at the facility as required by Appendix I;

(2) The location of each hazardous waste within the facility and the quantity at each location. For disposal facilities, the location and quantity of each hazardous waste must be recorded on a map or diagram of each cell or disposal area. For all facilities, this information must include cross-references to specific manifest document numbers, if the waste was accompanied by a manifest;

(3) Records and results of waste analyses performed as specified in § 264.13;

(4) Summary reports and details of all incidents that require implementing the contingency plan as specified in § 264.56(j);

(5) Records and results of inspections as required by § 264.15(d) (except these data need be kept only three years); and

(6) For off-site facilities, notices to generators as specified in § 264.12(b).

(7) All closure cost estimates under § 264.142, and, for disposal facilities, all post-closure cost estimates under § 264.144.

2. In § 264.75, revise paragraphs (e) and (f) and add paragraphs (g) and (h) to read as follows:

§ 264.74 Availability, retention, and disposition of records.

(a) All records, including plans, required under this Part must be furnished upon request, and made available at all reasonable times for inspection, by any officer, employee, or representative of EPA who is duly designated by the Administrator.

(b) The retention period for all records required under this Part is extended automatically during the course of any unresolved enforcement action regarding the facility or as requested by the Administrator.

(c) A copy of records of waste disposal locations and quantities under § 264.73(b)(2) must be submitted to the Regional Administrator and local land authority upon closure of the facility.

§ 264.75 Annual report.

The owner or operator must prepare and submit a single copy of an annual report to the Regional Administrator by March 1 of each year. The report form and instructions in Appendix II must be used for this report. The annual report must cover facility activities during the previous calendar year and must include the following information:

(a) The EPA identification number, name, and address of the facility;

(b) The calendar year covered by the report;

(c) For off-site facilities, the EPA identification number of each hazardous waste generator from which the facility received a hazardous waste during the year; for imported shipments, the report must give the name and address of the foreign generator;

(d) A description and the quantity of each hazardous waste the facility received during the year. For off-site facilities, this information must be listed by EPA identification number of each generator;

(e) The method of treatment, storage, or disposal for each hazardous waste;

(f) [Reserved]

(g) The most recent closure cost estimate under § 264.142, and, for disposal facilities, the most recent post-closure cost estimate under § 264.144; and

(h) The certification signed by the owner or operator of the facility or his authorized representative.

3. Revise § 264.77 to read as follows:

§ 264.77 Additional reports.

In addition to submitting the annual report and unmanifested waste reports described in §§ 264.75 and 264.76, the owner or operator must also report to the Regional Administrator:

(a) Releases, fires, and explosions as specified in § 264.56(j);

(b) [Reserved]; and

(c) Facility closure as specified in § 264.115.

e. Add new Subparts G, H, I, J, K, and L to Part 264 as follows; these Subparts are issued as interim final rules:

Section 264.73 Operating Record
Section 264.74 Availability, Retention, and Disposition of Records
Section 264.75 Annual Report
Section 264.77 Additional Reports

waste management facilities. Many of the subparts of Part 265 parallel those of Part 264 and also provide additional specific requirements with respect to monitoring, specific type of disposal facility, closure plans, post-closure care, and financial requirements. Part 265 is designed, primarily, to cover an operation that was in existence, or came into existence following enactment of the Resource Conservation and Recovery Act until a permanent program for new and existing facilities could be implemented under Part 264.

Subpart F of Part 265 requires that an owner/operator of a hazardous waste landfill implement a groundwater monitoring system capable of determining the facility's impact on the quality of groundwater in general, and specifically the facility's impact on the uppermost aquifer underlying the landfill.

Section 265.91 requires that a monitoring system consist of at least one upgradient and three downgradient wells placed in such a manner to obtain meaningful results.

The owner/operator must design, develop and implement a groundwater sampling and analyses program under Section 265.92. Minimum analyses requirements include the EPA primary drinking water standards, parameters for establishing groundwater quality, and parameters used for indicating groundwater contamination (Table 2). This section also requires a baseline monitoring program (265.92(c)[2]).

§ 265.92 Sampling and analysis.

(a) The owner or operator must obtain and analyze samples from the installed ground-water monitoring system. The owner or operator must develop and follow a ground-water sampling and analysis plan. He must keep this plan at the facility. The plan must include procedures and techniques for:

(1) Sample collection;
(2) Sample preservation and shipment;
(3) Analytical procedures; and
(4) Chain of custody control.

[*Comment:* See "Procedures Manual For Ground-water Monitoring At Solid Waste Disposal Facilities," EPA–530/SW–611, August 1977 and "Methods for Chemical Analysis of Water and Wastes," EPA–600/4–79–020, March 1979 for discussions of sampling and analysis procedures.]

(b) The owner or operator must determine the concentration or value of the following parameters in ground-water samples in accordance with paragraphs (c) and (d) of this section:

(1) Parameters characterizing the suitability of the ground water as a drinking water supply, as specified in Appendix III.

(2) Parameters establishing ground-water quality:
(i) Chloride
(ii) Iron
(iii) Manganese
(iv) Phenols
(v) Sodium
(vi) Sulfate

[*Comment:* These parameters are to be used as a basis for comparison in the event a ground-water quality assessment is required under § 265.93(d).]

(3) Parameters used as indicators of ground-water contamination:
(i) pH
(ii) Specific Conductance
(iii) Total Organic Carbon
(iv) Total Organic Halogen

(c)(1) For all monitoring wells, the owner or operator must establish initial background concentrations or values of all parameters specified in paragraph (b) of this Section. He must do this quarterly for one year.

(2) For each of the indicator parameters specified in paragraph (b)(3) of this Section, at least four replicate measurements must be obtained for each sample and the initial background arithmetic mean and variance must be determined by pooling the replicate measurements for the respective parameter concentrations or values in samples obtained from upgradient wells during the first year.

(d) After the first year, all monitoring wells must be sampled and the samples analyzed with the following frequencies:

(1) Samples collected to establish ground-water quality must be obtained and analyzed for the parameters specified in paragraph (b)(2) of this Section at least annually.

(2) Samples collected to indicate ground-water contamination must be obtained and analyzed for the parameters specified in paragraph (b)(3) of this Section at least semi-annually.

(e) Elevation of the ground-water surface at each monitoring well must be determined each time a sample is obtained.

Section 265.92 Sampling and Analysis

Sections 265.93 and 265.94 require that the owner/operator develop a groundwater assessment program to periodically analyze the data from the monitoring program, evaluate the results, and make annual reports to the Regional Administration.

Subpart G (Sections 265.111 through 265.116), of Part 265, requires that a hazardous waste facility closure plan be prepared that identifies the steps necessary to completely close the facility at any point in time during its intended life. At minimum, the closure plan must include (1) an estimate of the maximum inventory of wastes at the facility at any given time during the life of the facility; (2) steps needed to decontaminate facility equipment during closure; (3) anticipated date of final waste acceptance; and (4) date of final closure. The closure must be certified by an independent professional engineer (Section 265.115).

§ 265.115 Certification of closure.

When closure is completed, the owner or operator must submit to the Regional Administrator certification both by the owner or operator and by an independent registered professional engineer that the facility has been closed in accordance with the specifications in the approved closure plan.

Section 265.115 Certification of Closure

Sections 265.117 through 265.139 require the owner/operator to develop a post-closure monitoring and maintenance program that will cover a period of at least 30 years following closure (or other period of time as determined by the Regional Administrator). It is also

required that the owner/operator include information, with respect to the facility's use as a hazardous waste disposal site, on any land deeds and records that are kept to insure that, if and when ownership is transferred, the transferee is appraised of possible restrictions of this property (Section 265.120).

Sections 265.300 through 265.339 (Subpart N) generally deal with specific operations and performance requirements for landfill disposal of hazardous wastes. The general operating requirements include controlling run-off and run-on. Either diversion and/or collection is acceptable. If wind disposal of waste in the landfill may be a problem, a suitable cover is required. Cells must be accurately surveyed and located on suitable maps (Section 265.309). Records of cell sizes, volume of wastes and type of waste in each must be accurately recorded.

Section 265.310 amplifies the owner/operator responsibilities with respect to facility closure and post-closure care.

Sections 265.312 through 265.315 cover special requirements for dealing with ignitable, reactive, and incompatible wastes. Liquid wastes may not be emplaced in a landfill unless a liner is installed, the liquid is mixed with an absorbent solid or is physically and chemically stabilized. Containers may not be used.

§ 265.310 Closure and post-closure.

(a) The owner or operator must place a final cover over the landfill, and the closure plan under § 265.112 must specify the function and design of the cover. In the post-closure plan under § 265.118, the owner or operator must include the post-closure care requirements of paragraph (d) of this Section.

(b) In the closure and post-closure plans, the owner or operator must address the following objectives and indicate how they will be achieved:

(1) Control of pollutant migration from the facility via ground water, surface water, and air;

(2) Control of surface water infiltration, including prevention of pooling; and

(3) Prevention of erosion.

(c) The owner or operator must consider at least the following factors in addressing the closure and post-closure care objectives of paragraph (b) of this Section:

(1) Type and amount of hazardous waste and hazardous waste constituents in the landfill;

(2) The mobility and the expected rate of migration of the hazardous waste and hazardous waste constituents;

(3) Site location, topography, and surrounding land use, with respect to the potential effects of pollutant migration (e.g., proximity to ground water, surface water, and drinking water sources);

(4) Climate, including amount, frequency, and pH of precipitation;

(5) Characteristics of the cover including material, final surface contours, thickness, porosity and permeability, slope, length of run of slope, and type of vegetation on the cover; and

(6) Geological and soil profiles and surface and subsurface hydrology of the site.

(b) In addition to the requirements of § 265.117, during the post-closure care period, the owner or operator of a hazardous waste landfill must:

(1) Maintain the function and integrity of the final cover as specified in the approved closure plan;

(2) Maintain and monitor the leachate collection, removal, and treatment system (if there is one present in the landfill) to prevent excess accumulation of leachate in the system;

[*Comment*: If the collected leachate is a hazardous waste under Part 261 of this Chapter, it must be managed as a hazardous waste in accordance with all applicable requirements of Parts 262, 263, and 265 of this Chapter. If the collected leachate is discharged through a point source to waters of the United States, it is subject to the requirements of Section 402 of the Clean Water Act, as amended.]

(3) Maintain and monitor the gas collection and control system (if there is one present in the landfill) to control the vertical and horizontal escape of gases;

(4) Protect and maintain surveyed benchmarks; and

(5) Restrict access to the landfill as appropriate for its post-closure use.

40CFR267 - Parts 264 and 265 deal, essentially, with hazardous waste facilities that were in existence, or came into existence prior to RCRA and promulgation of the regulations corresponding to the Act. Part 267 deals, specifically, with new hazardous waste facilities coming into existence following adoption of Parts 264 and 265. The standards set forth in Part 267 are interim final status standards, pending the development of permanent land disposal standards for new and existing facilities.

Section 267.1 establishes the minimum national standards for hazardous waste management for new facilities and defines its applicability to the proposed landfill at RMA. Section 267.2 states that the owner/operator is subject to the requirements of parts 264 and 265.

Section 267.10 (Subpart B) lists the environmental performance standards to be addressed in the location, design, construction and operation of a land treatment facility for hazardous wastes. Of specific concern, with respect to the RMA facility, are the environmental performance standards that require consideration of the surface and groundwater hydrology, the geologic setting and the irrigation potential of the hazardous wastes. It is unlikely that the proposed disposal at RMA will have any effect on air quality (Section 267.10[c]).

However, the performance standards with respect to air quality under Section 267.10[c] require that potential adverse effects on air quality, as a result of the operation of a hazardous waste disposal

§ 267.10 Environmental performance standard.

All new landfills, surface impoundments, land treatment facilities and underground injection wells shall be located, designed, constructed, operated, maintained and closed in a manner that will assure protection of human health and the environment. Protection of human health and the environment shall include, but not be limited to:

(a) Prevention of adverse effects on ground-water quality considering:

(1) The volume and physical and chemical characteristics of the waste in the facility, including its potential for migration through soil or through synthetic liner materials;

(2) The hydrogeological characteristics of the facility and surrounding land;

(3) The quantity, quality and directions of ground-water flow;

(4) The proximity and withdrawal rates of ground-water users;

(5) The existing quality of ground-water, including other sources of contamination and their cumulative impact on the ground-water;

(6) The potential for health risks caused by human exposure to waste constituents;

(7) The potential damage to wildlife, crops, vegetation and physical structures caused by exposure to waste constituents;

(8) The persistence and permanence of the potential adverse effects; and

(b) Prevention of adverse effects on surface water quality considering:

(1) The volume and physical and chemical characteristics of the waste in the facility;

(2) The hydrogeological characteristics of the facility and surrounding land, including the topography of the area around the facility;

(3) The quantity, quality and directions of groundwater flow;

(4) The patterns of rainfall in the region;

(5) The proximity of the facility to surface waters;

(6) The uses of nearby surface waters and any water quality standards established for those surface waters;

(7) The existing quality of surface water, including other sources of contamination and their cumulative impact on surface water;

(8) The potential for health risks caused by human exposure to waste constituents;

(9) The potential damage to wildlife, crops, vegetation and physical structures caused by exposure to waste constitutents;

(10) The persistence and permanence of the potential adverse effects; and

(c) Prevention of adverse effects on air quality, considering:

(1) The volume and physical and chemical characteristics of the waste in the facility, including its potential for volatilization and wind dispersal;

(2) The existing quality of the air, including other sources of contamination and their cumulative impact on the air;

(3) The potential for health risks caused by human exposure to waste constitutents;

(4) The potential damage to wildlife, crops, vegetation and physical structures caused by exposure to waste constituents;

(5) The persistence and permanence of the potential adverse effects; and

(d) Prevention of adverse effects due to migration of waste constituents in the subsurface environment, considering:

(1) The volume and physical and chemical characteristics of the waste in the facility, including its potential for migration through soil;

(2) The geologic characteristics of the facility and surrounding land;

(3) The patterns of land use in the region;

(4) The potential for migration of waste constituents into sub-surface physical structures;

(5) The potential for migration of waste constituents into the root zone of food-chain crops and other vegetation;

(6) The potential for health risks caused by human exposure to waste constituents;

(7) The potential damage to wildlife, crops, vegetation and physical structures caused by exposure to waste constituents; and

(8) The persistence and permanence of the potential adverse effects.

facility, be considered. These considerations should include: (a) volatility of the hazardous material and effects of wind dispersal; (b) risk to human health; (c) cumulative impacts of other sources of air pollution; (d) potential damage to wildlife, crops, vegetation and physical structures; and, (e) the persistence and/or permanence of potential adverse effects.

Subpart C, of Part 267, deals, specifically, with general design and operating requirements of a hazardous waste landfill. The general design requirements under this section must take into consideration the nature of the wastes, the geochemistry of the enclosing soils, hydrologic pressures, climatic condition, leachate and runoff controls and a liner designed to satisfy the environmental performance standards of 267.10.

Section 267.22 defines the general operating requirements of a landfill and must be consistent with the performance standards of 267.10 and design criteria of 267.21.

Facility closure and post-closure care standards are defined in Section 267.23. Closure must be accomplished properly with respect to geohydrologic and climatic conditions, characteristics of the final cover and final land surface contours. The environmental performance standards of Section 267.10 must be considered. A monitoring program is required.

§ 267.21 General design requirements.

(a) Each landfill must include a liner designed to comply with § 267.10 of this Part. The design of the facility liner must reflect a consideration of:

(1) The physical and chemical characteristics of the waste in the facility;

(2) The pressure head of leachate on the liner;

(3) Climatic conditions in the area;

(4) The permeability of the liner material, including compaction density and moisture content where earthen materials are present;

(5) The physical and chemical properties of the soil underlying the facility that supports any emplaced liner; and

(6) The potential for damage to the liner system that could occur during installation of any emplaced liner.

(b) Each landfill must include a leachate and runoff control system designed to comply with § 267.10 of this Part. The design of the facility leachate and runoff control system must reflect a consideration of:

(1) The physical and chemical characteristics of the waste in the facility;

(2) Climatic conditions in the area;

(3) The volume of leachate or contaminated runoff that could be produced at the facility; and

(4) The available options for managing any leachate or contaminated runoff that is collected at the facility.

Section 267.21 General Design Requirements

§ 267.22 General operating requirements.

(a) Incompatible wastes, or incompatible waste and materials, must not be placed in the same landfill, unless § 264.17(b) is complied with. The waste analysis plan required by § 264.13 must include the analysis needed to comply with this paragraph.

(b) Any emplaced liner material must be installed in a manner that will protect the function and physical integrity of the liner.

(c) The leachate and runoff control system must be operated and maintained in a manner that will comply with § 267.10 of this Part. The procedures for operating the leachate and runoff control system must reflect a consideration of:

(1) The volume of leachate or contaminated runoff produced at the facility;

(2) The capacity of any leachate or runoff collection device at the facility;

(3) Climatic conditions in the area; and

(4) The quality of the leachate or runoff produced and the available alternatives for managing any leachate or contaminated runoff produced at the facility.

(d) The landfill must be inspected at a sufficient frequency to assure compliance with § 267.10 of this Part.

§ 267.23 Closure and post-closure.

(a) A landfill must be closed in a manner that will comply with § 267.10 of this Part. Closure must include placement of a final cover over the landfill, and the closure plan under § 264.112 of this Chapter must specify the function and design of the cover. Proper closure of a landfill must reflect a consideration of:

(1) The type and amount of waste in the facility;

(2) The mobility and expected rate of migration of waste;

(3) Site location, topography and surrounding land use;

(4) Climatic conditions in the area;

(5) Characteristics of the cover including material, final surface contours, thickness, porosity and permeability, slope, length of run of slope, and type of vegetation on the cover; and

(6) Geological and soil profiles and surface and subsurface hydrology of the site.

(b) A landfill must be maintained in a manner that complies with § 267.10 of this Part during the post-closure period. The post-closure plan under § 264.118 of this Chapter must specify the procedures that will be used to satisfy this paragraph. Proper maintenance of a landfill during the post-closure period must reflect a consideration of:

(1) The type and amount of waste in the facility;

(2) The mobility and expected rate of migration of the waste;

(3) Site location, topography and surrounding land use;

(4) Climatic conditions in the area;

(5) Characteristics of the cover including material, final surface contours, thickness, porosity and permeability, slope, length of run of slope, and type of vegetation on the cover;

(6) Geological and soil profiles and surface and subsurface hydrology of the site; and

(7) The maintenance of any ground-water monitoring system or leachate and runoff control system at the facility.

Section 267.25 gives the Regional Administration and places additional requirements.

§ 267.25 Additional requirements.

The Regional Administrator may place additional requirements on owners and operators of new landfills, besides those otherwise required by this Subpart, where necessary to comply with § 267.10 of this Part.

Section 267.25 Additional Requirements

Subpart F (Sections 267.50 through 267.53) requires that a groundwater monitoring program be implemented as part of the facility's operation. The monitoring system must meet the environmental performance standards of 267.10.

40CFR122 - These regulations are, principally, designed to develop a consolidated permit procedure under EPA administered programs, including NPDES permits, hazardous waste permits and the underground injection control program. These regulations are administrative in nature and define what the permitting agency must include in its permit requirements.

Section 122.1 includes the basic permitting requirements for EPA programs.

Section 122.7 defines required inclusions in a permit application (see EPA Form 3510[5-80]). It also designates the specific conditions applicable to a permit.

Subpart B, of Part 122, sets forth the specific requirements for the RCRA permit program. This section specifies that the

§ 267.50 Applicability.

Each new hazardous waste landfill, surface impoundment, or land treatment facility must have a ground-water monitoring program, which includes a ground-water monitoring system, procedures for sampling, analysis and evaluation of ground-water data, and appropriate response procedures.

§ 267.51 Ground water monitoring system.

The ground-water system required by this Subpart must be capable of determining the facility's impact on ground-water in the uppermost aquifer so as to assure compliance with § 267.10 of this Part. The design of the ground-water monitoring system must reflect a consideration of:

(a) The placement and depth of monitoring wells that is necessary to obtain a representative sample of constituents in the uppermost aquifer, including those present in the ground-water upgradient from the facility;

(b) Measures such as casing which maintain the integrity of the monitoring well bore hole; and

(c) Measures which prevent contamination of ground-water samples.

§ 267.52 Ground water monitoring procedures.

(a) The ground-water monitoring procedures required by this Subpart must be capable of assuring compliance with § 267.10 of this Part. The procedures must reflect a consideration of:

(1) Sample collection procedures;

(2) Sample preservation and shipment procedures;

(3) Analytical methods;

(4) Chain of custody control; and

(5) Evaluation procedures, including methods for determining the extent and rate of migration of waste constituents.

(b) The ground-water monitoring procedures required by this Subpart must include appropriate procedures for when the ground-water monitoring program indicates that the facility is not in compliance with § 267.10 of this Part. Such response procedures must be contained in the contingency plan required by Subpart D of Part 264.

§ 267.53 Additional requirements.

The Regional Administrator may place additional ground-water monitoring requirements on owners or operators of facilities subject to this Part, besides those otherwise required by this Subpart, where necessary to comply with § 267.10 of this Part.

Section 267.50 Applicability
Section 267.51 Ground Water Monitoring System
Section 267.52 Ground Water Monitoring Procedures
Section 267.53 Additional Requirements

owner/operator of a hazardous waste management facility must submit Parts A and B (Forms 3510-1 and 3510-3) which include specific information on waste types and quantities, geology, hydrology and data. These forms must be submitted at least 180 days prior to commencement of construction.

3. State Regulations

The principal authority for State regulation of hazardous waste disposal facilities in Colorado comes from Article 15, Section 25, of the Colorado Revised Statutes, 1973, as amended, entitled "Management and Disposition of Solid and Hazardous Waste". The rules and regulations pertaining to solid and hazardous wastes, adopted by the Colorado Department of Health, govern the location, design and design performance of any hazardous waste disposal site which will be, or is proposed to be in operation after July 1, 1981. The rules and regulations adopted are, essentially, parallel to the Federal requirements under RCRA, particularly Part 267.

Rules and regulations under Part 2 define the requirements for siting a hazardous waste disposal site.

Rules 2.1 and 2.2 define the applicability of these regulations and provide definition for specific words and phrases.

Rule 2.3 requires that a certificate of designation be obtained from the Board of County Commissioners of the specific county in

question as a prelude to operating a hazardous waste facility within that governmental jurisdiction. The application for a certificate of designation must include both administrative and technical data relating to the design, operation and performance standards for such a waste disposal facility.

The present rules for a hazardous waste facility relate only to off-site disposal (Rules 2.4 and 2.5) as the minimum performance criteria and siting requirements for on-site disposal facilities have not yet been promulgated. However, it is likely that the off-site siting and performance criteria will be at least the minimum standards applied to on-site facilities. The absence of State on-site regulations notwithstanding, the EPA regulations will govern.

Rule 2.4, and its subparts, sets the minimum design performance criteria for disposal sites. The disposal site must be located and designed such that adverse effects on groundwater quality and surface water quality will be prevented (Rules 2.4.2 and 2.4.3). Various aspects of the disposal operation need to be considered, including the nature and volume of the waste, hydrologic setting, hydrologic characteristics of the soils, surface drainage characteristics, etc.

> 2.4.2. Hazardous waste disposal sites shall be located and designed such that the design performance will prevent adverse effects on groundwater quality, considering:
>
> a. The volume and physical and chemical characteristics of the waste in the facility, including its potential for migration through any liners provided in the design and the surrounding soils or bedrock strata;

b. The hydrogeological characteristics of the facility and the surrounding land and other site specific factors which are basic to preventing adverse effects on groundwater quality;

c. The quantity, quality, and directions of flow of groundwater;

d. The proximity of existing and planned groundwater users and the withdrawal rates of such uses;

e. The existing quality of groundwater, including other sources of contamination and their cumulative impact on groundwater;

f. The potential for health risks caused by human exposure to waste constituents;

g. The potential damage to wildlife, crops, vegetation, and physical structures caused by exposure to waste constituents; and

h. The persistence and permanence of the potential adverse effects.

applied to on-site facilities. The absence of State on-site regulations notwithstanding, the EPA regulations will govern.

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2.4.2. Hazardous waste disposal sites shall be located and designed such that the design performance will prevent adverse effects on groundwater quality, considering:

a. The volume and physical and chemical characteristics of the waste in the facility, including its potential for migration through any liners provided in the design and the surrounding soils or bedrock strata;

b. The hydrogeological characteristics of the facility and the surrounding land and other site specific factors which are basic to preventing adverse effects on groundwater quality;

c. The quantity, quality, and directions of flow of groundwater;

d. The proximity of existing and planned groundwater users and the withdrawal rates of such uses;

e. The existing quality of groundwater, including other sources of contamination and their cumulative impact on groundwater;

f. The potential for health risks caused by human exposure to waste constituents;

g. The potential damage to wildlife, crops, vegetation, and physical structures caused by exposure to waste constituents; and

h. The persistence and permanence of the potential adverse effects.

2.4.3. Hazardous waste disposal sites shall be located and designed such that the design performance will prevent adverse effects on surface water quality, considering:

a. The volume and physical and chemical characteristics of the waste in the facility;

b. The hydrogeological characteristics of the facility and surrounding land and other site specific factors which are basic to preventing adverse effects on surface water quality, including the topography of the area around the facility and any engineering features to influence surface water flow patterns that may be appropriate;

c. The quantity, quality, and directions of flow of surface water;

d. The patterns of precipitation in the region and potential impacts on disposal locations, including removal of wastes;

e. The proximity of the facility to surface waters;

f. The existing and planned uses of nearby surface waters and any water quality standards established for those surface waters;

g. The existing quality of surface water, including other sources of contamination and their cumulative impact on surface water;

h. The potential for health risks caused by human exposure to waste constituents;

i. The potential damage to wildlife, crops, vegetation, and physical structures caused by exposure to waste constituents; and

j. The persistence and permanence of the potential adverse effects.

Rule 2.4.5 requires that potential adverse effects on air quality be considered. At present, the Colorado Air Quality Control Commission does not have authority to regulate air quality standards for hazardous waste disposal facilities. The present authority lies with EPA, under the Clean Air Act, and RCRA, specifically 40CFR267. However, Colorado has authority to request air monitoring as part of the facility operations. Pre-operational and operational monitoring may be required in order to assess what, if any, air quality impacts might occur. Sufficient data from RMA should exist in order to develop an air quality model to assess what the impacts of an on-site landfill might be, given the physical and chemical nature of the hazardous waste and the meteorological setting.

Rules 2.4.5 through 2.4.7 deal with potential migration of waste constituents through the surface or subsurface environment. The performance standards require that the design and operation of the hazardous waste landfill facility prevent migration and may require a liner system, as well as a leachate and runoff control system, depending on the hydrogeologic and climatic setting.

Rules 2.4.8 and 2.4.9 deal with requirements for a closure plan and monitoring system for groundwater and surface water. The performance criteria include consideration of climate, waste migration potential, geologic setting, hydrologic characteristics, surface drainage, topography and land use.

Rule 2.4.10 requires that the design and construction of a hazardous waste landfill be supervised and certified by a professional geologist or engineer.

Rule 2.5, and its subparts, specify the minimum siting and design criteria for a hazardous waste landfill.

> 2.5.2. The proposed location, design, and design performance of a hazardous waste disposal site shall satisfy or satisfactorily mitigate the following conditions:
>
> a. Under normal climatic conditions odor-threshold concentration levels established in State air pollution regulations will not be exceeded;
>
> b. Proposed access routes shall be reasonably safe based on minimizing public exposure to transportation incidents, and a finding that such routes can be shown to meet or exceed classification standards for State roads;
>
> c. Adequate fire protection is provided on a 24-hour basis by an organized fire department or equivalent such service is provided by the owner/operator of the site;
>
> d. Adequate security is provided for the site and its operations on a 24-hour daily basis by security personnel and/or adequate security barriers to the site and its operations;
>
> e. The proper materials will be available in adequate supply for constructing liners or disposal cells and for providing a compacted impermeable cover to prevent any seepage into the completed fill upon closure; and

f. Adequate professional competence and resources exist to design and construct the site, to operate the site for its approved period of operation, and to provide for closure and post-closure care to guarantee long-term protection of public health and the environment.

Rule 2.5.3 requires that hazardous waste be emplaced in such a manner that the wastes are isolated away from the natural environmental pathways that could expose the public, for 1,000 years, unless some other time period is specified. Geologic, geomorphic, hydrogeologic, hydrologic and geochemical characteristics of the encapsulating medium must be considered in the design and operation of the landfill. The encapsulating medium, whether it is natural or engineered, will have a minimum permeability of 10^{-7} cm/sec, or be the equivalent or sufficient thickness to prevent migration to an agricultural or domestic water supply source.

A liner may be required (Rule 2.5.4) in order to meet the performance standards of Rules 2.4.1 through 2.4.5. Design considerations include:

a. The physical and chemical characteristics of the waste in the facility, including any treatment of wastes to promote the immobilization of hazardous substances;

b. The pressure head of leachate on the liner under worst case conditions;

c. The permeability of the liner material at specified compaction density and moisture content where earthen materials are used;

d. The potential chemical reactions between the wastes and the liner material that could affect the integrity of the liner;

e. The physical and chemical properties of the soil underlying the facility that supports any emplaced liner; and

f. The potential for damage to the liner system that could occur during installation or planned use.

Rule 2.5.6 requires that the disposal site be located such that, in the event of an unexpected discharge, the owner/operator can control the discharge to prevent adverse effects on public health.

The design criteria and performance standards set forth in these regulations satisfy any other applicable regulations dealing with solid waste disposal and water pollution control, as administered by the Colorado Department of Health.

IV. RECOMMENDATIONS

1. Given the volumes of material to be disposed of from Basin F, the uncertainty of availability for off-site disposal, it is recommended that RMA give serious consideration to developing its own on-site hazardous waste landfill. The attractiveness of this alternative is further increased if wastes other than Basin F material are to be disposed of. The incremental costs associated with disposing additional hazardous wastes at an on-site landfill would be much less than the additional costs for off-site disposal.

2. The preferred on-site disposal site in Section 36 appears to be suitable for a landfill facility. It is recommended that a detailed geotechnical investigation be undertaken for that site. It is further recommended that a baseline monitoring program, for both water quality and air quality, be implemented for that site to satisfy the regulatory permitting requirements.

3. If RMA chooses to proceed with the detailed investigation of the preferred Section 36 site, it is recommended that the appropriate regulatory officials from the EPA and Colorado State Department of Health be brought into the review and decision making process as soon as possible. This should help expedite the information gathering and permitting review process.